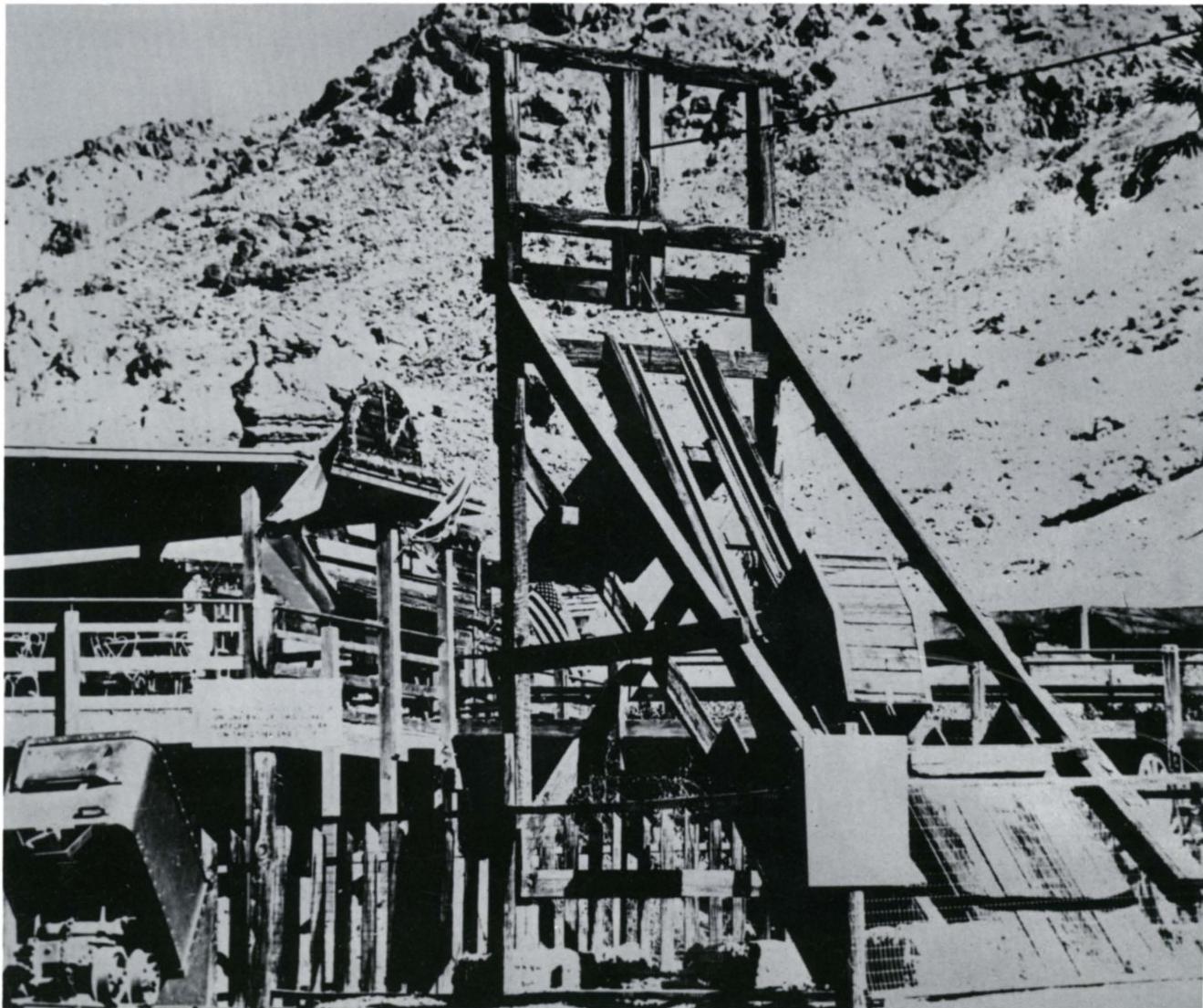


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SENTINELS IN THE WEST

HEADFRAME

- THE MORNING STAR MINE
- SILVER SENATOR
- CYANIDE IN THE ENVIRONMENT
- CALICO GHOST TOWN
- THE CALICO MINING DISTRICT
- SILVER IN HISTORY
- THE BATTLE OF SALAMIS
- AN IRON MAIDEN



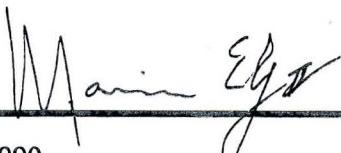
WELCOME TO HEADFRAME

Enter the world of mining and the 1990's with **Headframe** — an eclectic and unique magazine. Within its pages you will find mines, both new and old. Every mine is unique, as you will see. **Headframe** will discuss why the mine is where it is, the ore deposit, its mining, operation, and history. **Headframe** will also contain biographies, environmental issues, and wildlife. Within **Headframe** you will find a variety of departments, some of which will be introduced in future issues. In this issue we have all of the following:

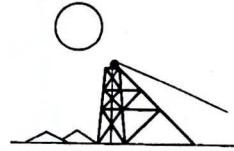
INSIDE STORY records the history of the future. Mining with rare exceptions is a short-term activity. Unlike a farm, a mine has a finite amount of mineral that will eventually become either uneconomical to recover or ultimately, exhausted. Many mines presently in existence will, before the turn of the century, cease operations and reclaim the land. Mines, like industrial plants, are not as a rule open to the public. Through the pages of **Headframe** we can take you to an operating mine to learn of its activities, and in the process record its history for the future. **MINING DISTRICTS** generally involves a historic mining district, the activities that have occurred there, and what remains. **ENVIRONMENT** discusses environmental issues generally relating to resources and the attendant social impacts. **PAST TENSE** presents items *verbatim* as originally published (including misspelling, grammar and other peculiarities). **ANTIQUITY** will generally provide information on mines and minerals from the distant past. **SPOTLIGHT** provides an account of an individual who has a place in the history of mines and mining. **MINING COUNTRY ADVENTURES** concerns family-related activities that can safely be enjoyed. These will be mine tours where available, special museums and special outings. Old mines can be especially dangerous and should not be visited by the general public. **CRITTERS** will be involved with wildlife of special concern. The "critter" highlighted in this issue is an exception to this general rule. **OLD TOOLS OF THE TRADE** will touch on tools and equipment of special interest that were used in the mining and milling of the past. The goal is to aid in the identification of relics found in and around old mining districts. The knowledge of such artifacts can add another dimension to the interpretation of a mine's history. **SIDETRACK**. We have all read an article or book in which a passing comment was made regarding a person, event, situation, or whatever, of which the author evidently *assumes* the reader is aware. Either the reader (a) comprehends the reference or (b) doesn't have the foggiest idea what is meant. In most instances (b) is the case. In the case of **Headframe**, Sidetrack may or may not necessarily be directly related to mining but will be of significant interest. The *Battle of Salamis*, herein, is an example. **FURTHER READING** will in some cases be a bibliography, in others, simply sources of additional information on the subject. **GLOSSARY**. Within each article in **Headframe** you may find some words in bold type. These words will be found in the back of the magazine (page 43). This feature is designed to inform and permit easier reading of the text.

We want **Headframe** to be interesting, informative, and in some cases challenging. If you can finish an article knowing something new, we will have achieved our goal.

We wish to establish a long relationship with our readers. Let us know of your interests and questions. Perhaps we can provide an answer in a future issue. If we have missed the mark let us know that too. We want the reading of **Headframe** to be a rewarding experience. Again, welcome to **Headframe**.



SENTINELS IN THE WEST **HEADFRAME**



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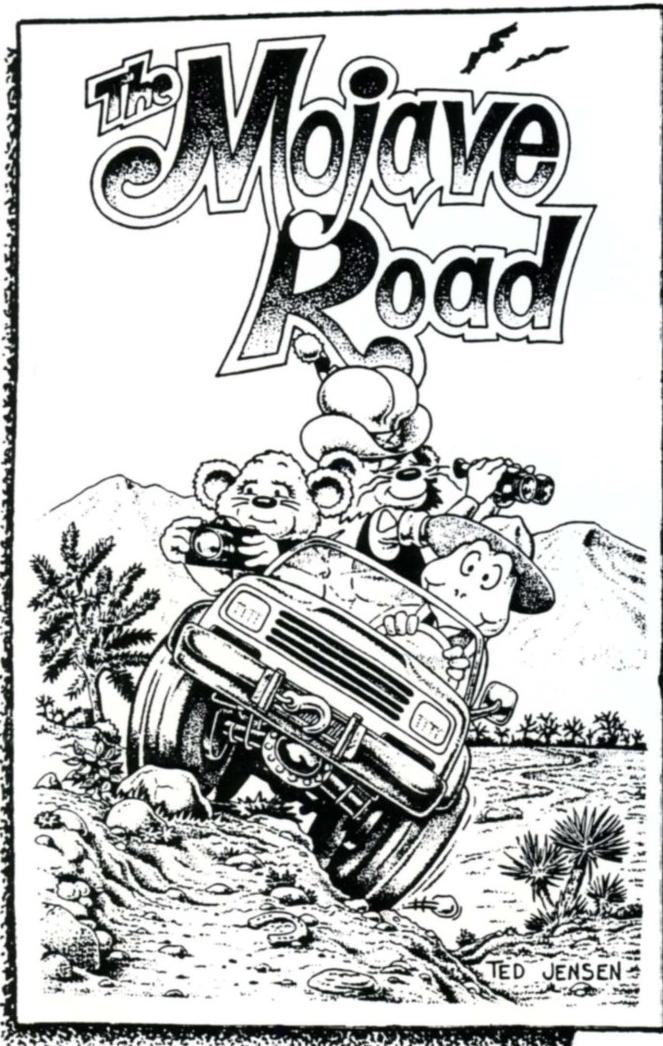
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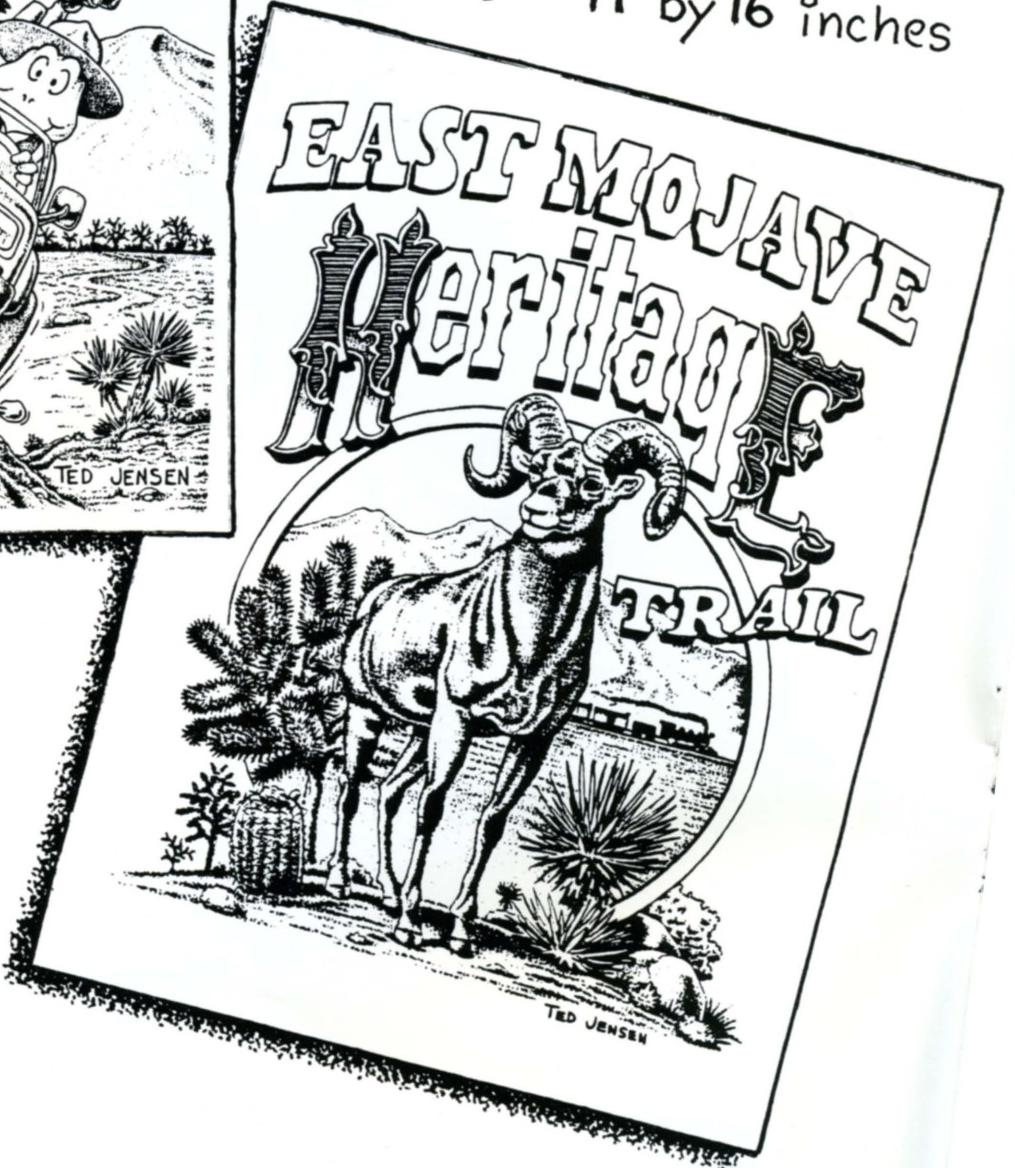
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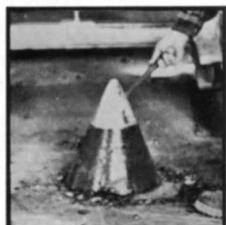
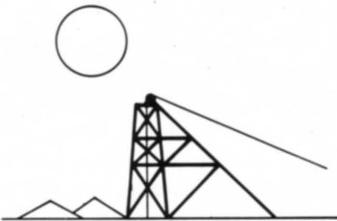
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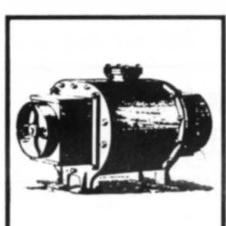
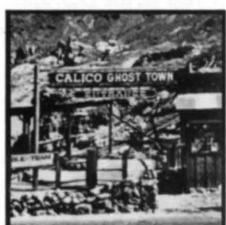
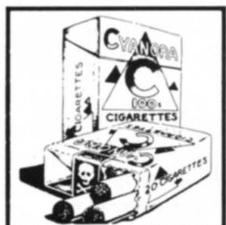
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Cover: A modern-day ghost town headframe, Calico, California.

INSIDE STORY

The Morning Star Mine

How It All Began

At the turn of the century mining activity began another upswing due to significant discoveries made in the west. In 1900 Jim Butler made a **bonanza** discovery of high-grade silver ore where the city of Tonopah later rose. In 1902 high-grade gold deposits were discovered at what became the town of Goldfield; in 1904 the discovery of gold in the Bullfrog District led to the community of Rhyolite. These and other discoveries attracted men from all over the west.

Typical of the times, those attracted often were not able to get in on the original strike. They did get some education on the geological peculiarities of these rich discoveries and, in some cases, made valuable discoveries themselves. If unsuccessful in their search, there was always a need for men in the mines.

Working in the rich mines gave them a more intimate view of the features surrounding the ore. Although lacking a formal geologic education (a fact which many were thankful for), these men attempted to grasp the basics of the ore deposit. In time, and armed with this knowledge, they would strike out on their own in an attempt to strike it rich by finding a similar deposit.

Prospectors would fan out over the countryside either singly or in small groups for miles in all directions. Their random searches focused on rocks and **float** that might lead them to their elusive goal. If successful they might even enter that exclusive pantheon of those that had made the big strike and rose from rags to riches. Many made discoveries that did not make them rich and whose importance, more often than not, would not be fully recognized for decades.

Discovery

In 1905 such a discovery was made in the Ivanpah Mountains of eastern



Morning Star Mine Crushing Plant

San Bernardino county, California. Completion in that year of the Union Pacific Railroad line to Nevada radically improved access to the Kewanee Mining District which included the Ivanpah Mountains. On the east side of the mountains was a hill that rose nearly 500 feet above the **alluvium** that skirted around its base. On its south side were found **outcrops** of small but high-grade **quartz** veins. The outcrops were stained with the typical green patina of copper minerals, but more importantly, contained both gold and silver. The ore deposit that gave existence to the Morning Star Mine had been discovered.

Following these veins into the hill the miners created **adits**, **tunnels** and developed a number of **drifts**,

levels, **winzes** and **raises**. Other discoveries were made in the area and other miners began digging into the mountainsides. Small **headframes** were constructed over some shafts while others depended on the **windlass**. Small isolated camps were set up around these workings but no large community developed. Operations continued intermittently over several decades with varying results. In the late 1930's the property was acquired by the Haliburton Oil company.

The deposit was explored and the original **workings** were extended and expanded until approximately 2,000,000 tons of ore was **blocked-out**. Underground operations were envisioned and by the early 1940's development of the property was underway as plans were being implemented to place the mine into production. In this process over 8000 feet of workings were constructed and, in the process some 83,000 tons of ore was produced.



Old Headframe Near Morning Star

L-208 Closed 10,000 Mines

Events in Europe and the Pacific interrupted these preparations with the unfolding of World War II. In 1942, the issuance of the War Production Board order L-208

forced the closing of nearly 10,000 mines in the western United States. One of these was the Morning Star Mine.



Haliburton Structures

When hostilities ended in 1945, a peace-time economy returned. The inflation caused by war and the fixed price of gold worked at crossed purposes. Expectations in 1945 were for the price of gold to be raised by the government from \$35 to \$45 per ounce but this did not occur.

The mining industry then entered a period of depression that, exacerbated by post-war inflation, persisted for decades. Capital for mines was nearly non-existent, and interest in some areas was extinguished. Numerous attempts were made to reopen the thousands of mines closed by L-208, but the pre-war price of gold could not support the post-war costs. Thousands of mines were thus unable to reopen and in some cases they were abandoned by their owners. A persistent few continued to do the work necessary to hold their mining claims under the law, expending labor, time and money in the belief that things would somehow change. Change, however, was decades away.

In 1964 the Vanderbilt Gold Corporation acquired the Morning Star Mine. This acquisition was followed by sampling and drilling of the property and the addition of a number of claims.

On March 17, 1968 the government ceased purchase and sale of domestically produced gold, a practice begun in 1834. At the same time it also became legal for citizens to hold gold, a right denied the public since 1933. A transition to a free-market supply and demand price structure began. On November 13, 1973, the government finally got out of the gold price-fixing business and the price began to rise.

There was a renewed interest in gold properties all over the country. In 1974, at the Morning Star Mine, a new exploration program was begun along with new geologic studies. Favorable results from these activities resulted in the decision to reopen the mine. The necessary capital was raised and in 1979 the Morning Star Mine was reopened as an underground mine.



Exploration Drilling

Ore Deposit Genesis

An estimated 135-195 million years ago, during the **Jurassic Period**, this area of California was literally a land where dinosaurs roamed the earth. This habitat ranged across Arizona and into Nevada, Arizona, Utah, New Mexico and Colorado. This portion of the land was somewhat drier and large areas of windblown sand later became the red Aztec sandstone. (This sandstone can be seen today west of Las Vegas, Nevada, and points east.)

As the Jurassic ended, a period of considerable crustal activity occurred. Enormous bodies of **igneous** rock called **batholiths** with areas measured in **hundreds** of square miles moved into the upper reaches of the crust. Above the batholiths volcanic rocks moved within a few miles of the surface. In response to this movement and the stresses it made on the overlying rock, volcanic eruptions broke out across the

land. Outpourings of lava, ash and broken rocks from below were cast onto the surface. During periods of eruption the days were darkened by the dark billowing clouds that rose from the throats of volcanoes and rose thousands of feet into the air. After an incredibly long period of time (an estimated 100 million years) this activity subsided but did not entirely cease; the last eruption occurred some 400 years ago.

During this period of time the **quartz monzonite** which forms the Ivanpah Mountains moved towards the surface over a very large area. Approximately seven miles to the southwest a **magma chamber** rose toward the surface. Its upward movement broke the overlying rocks, creating faults that moved them. Assemblages took shape that would later be raised above the surface to form new mountains.

A **thrust fault** broke through the lower reaches of the embryonic Ivanpah Mountains and, angling up from west to east, pushed the upper portion over the lower, and toward the surface. Somehow tapping the **hydrothermal** fluids in the magma chamber below, these mineralizing solutions moved along the thrust fault and other fractures. When conditions were right, minerals were deposited within this system of faults and fractured rock.

The Morning Star Ore Deposit -Part One

The ore deposit of the Morning Star Mine is a low-temperature system of presumed **Tertiary** age. The deposit contains disseminated gold, minor amounts of silver and **base metal** mineralization contained within Jurassic age granite. The ore occurrence is localized in the hanging wall of the Morning Star Thrust Fault which dips west at 31°, into the earth.

The Morning Star Thrust Fault is underlain by a dark **dike** on its **footwall**. Movement up the fault totally crushed and ground the rock for as much as 20 feet above the footwall. The introduction of hydrothermal fluids into this mass of ground rock

altered it to a clay **gouge**, creating a mass up to five feet in thickness above the footwall. Subsequent movement and hydrothermal activity through this conduit resulted in its permeation with minerals containing iron, copper, lead, zinc and, most importantly, gold and silver.

High-grade quartz veins containing gold in an alloy with silver called **electrum** laced the fault zone. These were the outcrops discovered in 1905. Outside the veins and above the clays, electrum peppered the remaining material.

Mineralization of the Morning Star Fault Zone occurred at two different times and under differing conditions. The first period of mineralization occurred with temperatures of 280-305° Centigrade (C). During this period of mineralization hematite (Fe_2O_3), pyrite (FeS_2), galena (PbS), sphalerite (ZnS), chalcopyrite ($CuFeS_2$), electrum, carbonates and some other minerals were deposited. The electrum was around 650 fine (650 parts gold) and is contained as grains within the quartz and pyrite. These grains occur as discrete, fine to coarse sized particles with a maximum dimension of 0.46 inches (1.17 mm). The hydrothermal solutions contained sulfur (S_2), oxygen (O_2) and carbon dioxide (CO_2).

During the second period of mineralization the levels of sulfur and oxygen were lower. Copper minerals made their appearance during this period: malachite ($Cu_2CO_3(OH)_2$), azurite ($Cu_3(OH)_2(CO)$), covellite (CuS), and tenorite (CuO). Acanthite (Ag_2S), **native** bismuth and uytenbogaardtite (Ag_3AuS_2) are first seen. The electrum deposited during this period had a fineness exceeding 820.

This 20 foot thick deposit was 1300 feet long and extended down dip from its outcrop on the east side of the mountain 1400 feet. At this point the ore was no longer **oxidized** and unoxidized sulfides became dominant. Sulfides present a physical barrier that prevents the gold recovery solutions from reaching the particles of gold. This marked the extent of the ore that could be economically recovered without a

costly treatment of the sulfides, necessary to liberate the gold. This deposit contained approximately 6,000,000 tons of ore.

Underground Operations

In 1979 preparations were then initiated to begin underground mining of the deposit. Due to the change in economics effected by World War II and technology, machinery rather than large numbers of men with picks and shovels would be used. The labor would be provided by machinery with sinews of steel and muscles powered by hydraulic fluids and compressed air.

across the valley. While the underground preparations were being made the mill would be made ready. In the process of opening up the workings it was decided to begin metallurgical experimentation and to debug the recovery system. Adjacent to the mine two 5000 ton concrete vats, triangular in cross-section were loaded with the material recovered from enlargement of the workings. To everyone's pleasant surprise, significant amounts of gold and silver were recovered, probably from hidden pockets adjacent to the workings. This was the first cash-flow provided by the mine in decades.

Once the mill was refurbished and placed into operation, the vats were



Morning Star Vats

Holes would be drilled with compressed air-driven equipment. Dynamite would free the ore from the enclosing rock. Specially designed front-end loaders that would also act as trucks would carry ore and waste rock to the surface.

In order to get this motorized equipment underground, the workings had to be enlarged. Designed for men, these workings were typically about five-feet wide and seven-feet high. This was adequate for men pushing ore cars along tracks but not for trackless equipment. The workings were then opened up to about 12 to 14-feet in width and the height to 12 feet.

The ore was to be processed in the refurbished Vanderbilt Mill located about 16 miles from the mine and

not used. The ore was trucked across the valley where it was leached in steel vats. This process was continued until the declining price of gold and the rising costs of operation were clouding the future of the mine. Then a fortuitous discovery occurred.

The Morning Star Ore Deposit- Part II

One of the reasons the small mountain existed over the ore deposit was its quartz content. Being somewhat higher than the rest of the area's quartz monzonite, it was more resistant to the erosive forces that had worn down the countryside over

Headframe

the millennia. It was also capped with about 80 feet of quartz.

An ongoing exercise at an operating mine is the unraveling of the deposit's geology. Faulting effects, different rock types and ore deposition controls are all items of significant interest. No one has X-ray eyes and the power to see beneath the earth's surface. Even with the sophisticated remote-sensing devices of today's technology, the subsurface geology is not certain until it is revealed by actual excavation.

Because of such factors as topography, economics, and environmental concerns, exploration drilling is accomplished on patterns that are rarely less than 100 feet on center. More often than not, the drilling locations are a compromise based primarily on regulatory agency constraints derived from excessive and unrealistic concerns about vegetation or habitat engendered by preservation groups. It is a rare project that is actually able to drill where the geologic extrapolations suggest. As a result, mining operations are handicapped by a lack of data and gaps in information occur. In this instance the local Bureau of Land Management office was very cooperative and the modest drilling proposal was approved.

Some speculation about the nature of the mountain above the ore deposit lead to the decision to gamble on another exploration program. Other than shallow pits, none of the previous mining had entered into the area between the deposit and the top of the mountain. This time drilling would be done from the top of the mountain. Costs for the drilling alone were about \$20 per foot of hole.

A series of holes were drilled through the quartz cap, through the mountain and into the ore body being mined. The results were incredibly good. The gamble had paid off. There was much jubilation.

Like a Cake!

It was discovered that there were other faulted zones roughly parallel to the Morning Star Thrust Fault. Although not as well developed as

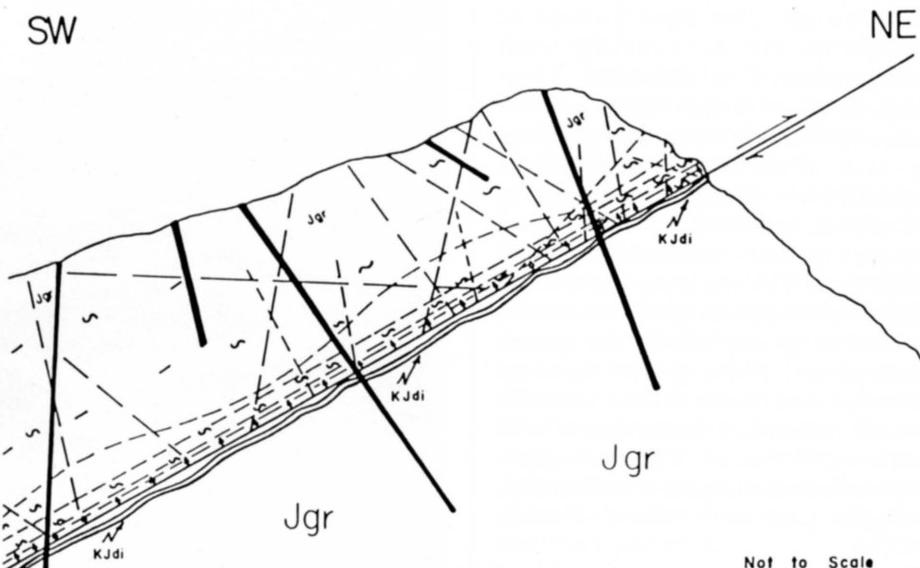
the thrust fault adjacent to the ore body, additional fracturing had occurred as a result of ancient crustal forces breaking large volumes of rock within the mountain. Although invisible from the outside surface, these fractures provided channels for hydrothermal solutions that had coursed through the rock in times past. The effect was likened to "icing in a multi-layered cake". This icing however, contained gold and not sugar.

The ore zone was now found to be 104 feet thick. Gold values within the deposit are highly variable and



Removing the Cap

can range from 0.01 ounce per ton up to several ounces per ton. The net effect was an ore averaging 0.047 ounces of gold per ton. For every ounce of gold recovered, 0.67 of an



SCHEMATIC X-SECTION THROUGH THE MORNING STAR OREBODY.

EXPLANATION

- Qal : QUATERNARY ALLUVIUM
- ▨ KJdi : CRETACEOUS - JURASSIC DIORITE DIKE
- Jgr : JURASSIC IVANPAH GRANITE

- MORNING STAR THRUST FAULT ; TEETH ON UPPER PLATE (PLAN VIEW)
- MORNING STAR THRUST FAULT ; (X-SECTION)
- - APPROXIMATE LIMIT OF ORE GRADE MINERALIZATION AWAY FROM THE UPPER PLATE - THRUST FAULT CONTACT
- MINERALIZED STRUCTURES : CONFINED TO UPPER PLATE. STRIKE N-S TO E-W DOMINATELY NE.
- POST MINERALIZATION STRUCTURES (FAULTS - FRACTURES).
- BRECCIA - STOCK WORK VENING. CONFINED TO WITHIN A FEW FEET OF THE UPPER PLATE - THRUST FAULT CONTACT WITHIN THE UPPER PLATE.
- MYLONITE FOLIATION ; APPROXIMATELY COPLANAR WITH THE PLANE OF THE MORNING STAR THRUST FAULT.

by Kent Ausburn

Morning Star Mine Ore Body

ounce of silver is also produced, a ratio of 1.5 to 1.

Eureka!

Another welcomed surprise occurred in 1985 when a high-grade block of ore was found that had apparently eluded exploration drill holes. Approximately 20,000 tons of 0.3 ounce gold ore was revealed. About 400 pounds of gold was contained in this one block of ore.

The Bureau of Mines conducted a study of the ore deposit to test its potential for *in situ* leaching. The deposit was considered a potential candidate given its geometry and the impervious and thick layer of clay at its base, and no ground water below. The study showed that if solution was introduced at the top of the mountain it would, after traveling several hundred feet, create a very narrow cone only 75 feet in diameter at the clay layer.

This meant that a series of shallow holes could be drilled on top of the mountain and the leaching solution introduced. Then the solution could have then been collected in the workings after percolating through the rock and dissolving the gold and silver. This method promised virtually no surface disturbance, excellent control and far lower operating costs. It was a feasible project.

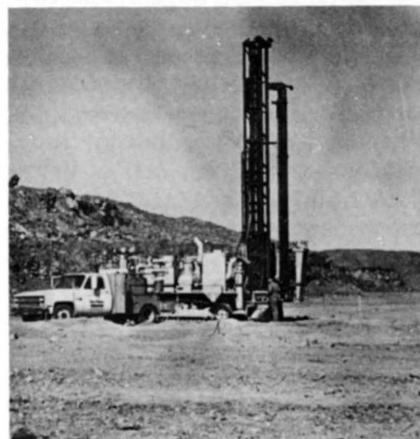


Crushed Ore Stockpile

After investigating the possibilities, the company decided not to attempt the project. Although being environmentally sound, preservation groups could cause endless delays with their specious arguments that regulatory agencies would need to respond to. The potential for increased costs and endless delays in obtaining the necessary permits was so great that

the project was not considered worthwhile. Recent history has shown this to have been a wise decision. Another company has suffered a three-year delay and added costs of over \$3,000,000 to-date in attempting to open up a mine in the region—and this with no spotted owls!

Open Pit Operations



Morning Star Pit

In 1984 all of the necessary actions required for conversion to an open pit operation had been completed. The lengthy haul of ore to the Vanderbilt Mill had been eliminated with the construction of an 13-acre heap leaching pad and precious metal recovery system at the mine.

Mining is now accomplished through the use of conventional open pit techniques. The open pit is about 20 acres in size. Operations begin with conventional blasting of the ore.

In the ore zone the blast-hole locations are surveyed as determined by the ever-changing mine map. Six-inch holes are drilled to pre-determined depths by self-propelled drill rigs. All drill cuttings are sampled and assayed to ascertain if the rock is ore or waste—a decision that cannot be made visually. Ore is drilled on 10-foot centers and is mined from 15-foot high benches. Waste is drilled on 14-foot centers and is mined from 30-foot high benches.

When the drilling pattern has been completed, the blast-holes are loaded with a mixture of ammonium nitrate and diesel oil. A stick of dynamite is then used to detonate

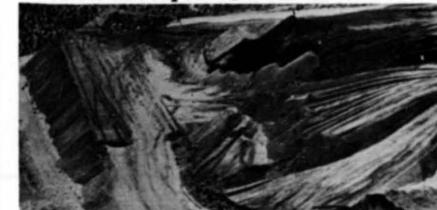
each hole. Split-second delays are used in the timing sequence so that the blasted material is fractured in a specific sequence and direction.

After blasting, the broken ore and rock is loaded onto 50-ton trucks by power shovels. The waste is taken to the east side of the pit which is also the east side of the mountain, where it is dumped. The ore is loaded in the same manner and is transported to the crushing plant.

The crushing plant is located between the pit and the heap leach pad. The multi-stage crushing plant uses a large (32"x 40" mouth) jaw crusher, two smaller gyratory crushers and a series of vibrating screens. The crushers and screens are inter-connected by conveyors which move the ore through the crushing circuit. The final product is a pea-gravel (3/8 inch and smaller), which exits the crushing plant onto a stockpile next to the heap leach pads. From the stockpile the crushed ore is taken to the heap leach pad for leaching.

Heap Leaching

Heap leaching technology has revitalized the gold mining industry during the last 15 years. Utilizing the ability of weak cyanide solutions to dissolve both gold and silver, this system can recover these metals from crushed ore [see *Cyanide in the Environment*, p. 10].



Loading Pad #1

In heap leaching, crushed ore is placed onto an impermeable plastic membrane. Once in position, a weak (0.05%, 500 ppm) cyanide solution operating at a pH of about 10.8, is introduced to the top of the heap. As this solution percolates through the ore it becomes pregnant with dissolved gold and silver along the way. Moved by gravity, the pregnant solution finally encounters the impermeable plastic sheet. It then

drains to the low end where it is collected and pumped to a recovery system. When the precious metals are removed, the solution is then brought back up to strength and is recirculated back through the heap.

The backbone of a heap leach system is the pad. It must collect the pregnant solution and conduct it to the point of transfer to the recovery plant. The pad liner must maintain its integrity and not leak. A leaking pad loses not only solution but money. Every effort possible is therefore put forth to assure that the liner does not leak, and if it does to collect the solution.

At the Morning Star Mine, Pad #1 is 920' x 620' and contains about 1,000,000 tons of ore. Before the plastic liner was put in place the site was graded to the slope necessary (2%), to drain the pad. The pad base is a six-inch compacted, graded and smoothed fill composed alluvium and clay imported from nearby Ivanpah Dry lake.

On top of the base a perforated plastic pipe drain network was positioned in the base. Any solutions captured by this system would be drained into the pregnant solution pond. A 40 mil (0.040 inch) high density polyethylene (HDPE) synthetic liner was then put in place. A leak detection system was then put in place (which could also drain to the pregnant solution pond), and another layer of HDPE was put on top of this system. The HDPE is a very strong synthetic plastic that can support up to 150 feet of ore.

On top of this double-lined system the leachate collection system was placed. Four-inch perforated plastic pipes running north to south across the pad were positioned 20-feet apart. These pipes were connected to an eight-inch perforated plastic pipe which drained the system into the pregnant solution pond. A geotextile similar to glass wool was then placed over the leachate collection system. A two-foot thick layer of crushed rock was placed over this material and the pad was ready to receive ore.

Drip is good!

The crushed ore was placed in

prisms 120' x 850' by 13 feet high across the pad. Each of these held approximately 75,000 tons of ore. The barren cyanide solution was originally applied to the top of the heap by sprinklers but in 1988 the system was converted to a drip irrigation system. This advancement lowered evaporation losses 90%. This amounted to a minimum savings of 6,000,000 gallons of water (18.4 acre-feet) per year.

In early 1990, Pad #2 was constructed. It utilizes another advance in heap leach design: a cellular complex pad. Rather than a single large pad like Pad #1, the pad is a complex composed of a number of independent cells. Each cell is below grade and is constructed in a manner similar to that of Pad #1. Each cell is designed to collect the leachate and to contain any precipitation falling on it without overflowing. Being in effect a vat, by flooding the cell, total contact of ore with cyanide solution can be easily effected.

This system has a number of other advantages. A cell being smaller than the total pad complex, it can be constructed quicker and be put into production faster than a large pad. Individual cells on a pad complex can be placed into production while other cells are being constructed. A heap can be placed on top of the cell, above the level of saturation and be leached in the conventional manner. When adjacent cells have completed leaching, the space between them can be filled with a prism of ore, further extending the life of the system. Conversely, when the point of diminishing returns has been reached with a given cell, its detoxification and reclamation can begin. A pad complex can therefore contain cells at every stage of operation, detoxification and reclamation.

Precious Metal Production

The pregnant solution drains from the pad or is pumped from the cells into the pregnant solution pond. The pond covers about one-acre and

has a capacity of 1,700,000 gallons. It is also of double-lined HDPE construction similar to that of the pads. It is fenced with chain-link and a locked gate to keep out wandering cattle and other wildlife in the area. A plastic netting of two-inch mesh is suspended by cables over the ponds to exclude birds. Some birds dive-bomb through the netting and, after drinking the water, succumb to cyanide poisoning. Although there is no question in the operators minds as to the cause of death, the Bureau of Land Management, in response to cries from preservationists, requires that the dead birds be stored in a freezer. The remains are periodically collected and shipped to a lab for autopsy. Fortunately the numbers are small and a storage problem does not arise.



Pregnant Solution Pond

The pregnant solution is pumped from the pregnant solution pond to the recovery plant. The arriving solution is circulated through five, six-foot diameter carbon columns containing two tons of coconut charcoal. The gold and silver are adsorbed onto the charcoal and the now barren solution is discharged to two barren solution ponds of 707,000 gallons capacity.

Water from a 100,000 gallon capacity fresh water pond is added to the barren solution to restore the volume lost through evaporation. Sodium cyanide (NaCN) and caustic soda (NaOH), are added to the barren solution to bring it back up to working strength. The renewed solution is then pumped back to the leach pads where another cycle begins.

Coconut charcoal is used because of its mechanical strength. Theoretically one ton of charcoal can adsorb up to 400 ounces of precious metals. Periodically the charcoal is transferred into one of two strip-tanks where it is subjected to a hot al-

coho/caustic solution. This solution strips the gold and silver from the charcoal, sending them back into solution. This solution is then pumped through an electrowinning cell where the gold and silver (and some copper) is electrically plated onto steel wool.



Charcoal Columns

The steel wool is periodically collected and mixed with a refining flux. This material is then placed into a furnace where it is melted. The molten material is then poured into one-inch thick steel conical molds. The gold and silver being heavier than the **dross**, sinks to the bottom of the mold. The alloy contains a mixture of gold and silver and, when cooled, is called a **doré** bar. This is the final product.

A sample is taken from the doré bar for company assay. The doré bar is collected by armed guards on an unscheduled basis and is transported to a refinery where the final separation of gold and silver is made.



Doré!

Just a Few Tons

The Morning Star Mine, since operations were renewed in the 1970's and through 1989, has produced 160,000 troy ounces (10,971 pounds or 5.485 tons) of doré. Of this, 60,000 troy ounces

(4114 pounds or 2.057 tons) of gold and 100,000 troy ounces (6857 pounds or 3.428 tons) of silver.

Presently there are ore reserves of 4,700,000 tons grading 0.05 ounces per ton remaining in the mine. This indicates a potential production of approximately 735,000 ounces of gold and perhaps 156,000 ounces of silver. At the presently projected rates of mining these reserves will be exhausted in 1995.

However, there may be additional discoveries as a result of exploration activities at the Morning Star Mine. As has happened before, there may also be some surprises.

Reclamation

The first reclamation plan for the Morning Star Mine was developed in 1979. It has been subsequently revised as situations have changed at the mine. Experimentation with the transplantation of barrel cacti and Joshua trees has resulted in a survival rate of about 75%.



Transplanted Cacti

Revegetation techniques and various seed mixes have also been tried. The worst being a native seed mix suggested by a regulatory agency. All recommendations were followed and nothing grew. Observations at the site seemed to indicate that the birds, ants and rodents were very grateful for the meals. Experiments continue.

Potential for the site with its developed water and power are endless. It could become a campground or a natural oasis. As has occurred elsewhere in the California desert, open pits evolve through relatively short periods of time, dependent on rainfall, into oases. A pool of water surrounded by native plants naturally invading the site results. It becomes a focus for wildlife of all

kinds.

An Inch of Rain...

The company is presently proposing to leave the pregnant solution pond in place with Pad #1 draining into it. Neutralization of the pad is currently underway. Precipitation falling on the heap will percolate through to the pad and feed the pool. This water source will produce 325,830 gallons of water for every inch of rain that falls. This will likely result in a second oasis at the mine that will be of benefit to wildlife. With these new water sources as a result of the mine, wildlife densities will be higher than they were before the mine began operation when no sizeable natural water sources existed.

In Toto

The Morning Star Mine appears to be nearing the end of its days as a mineral producer. It has been a "late bloomer" but a good producer. Beginning as a small mine, its size increasing with each new discovery, its production and contribution to the economy is not insignificant. It employs about 40 people and tax payments alone have totaled nearly \$2,000,000.

The ore deposit vagaries noted here are typical of many mines. Such discoveries have been and will be experienced elsewhere. At this point in time however, no one can tell for certain what the next exploration drill hole at the Morning Star Mine may reveal.

J. E. Emerson's Eyeless Pick.

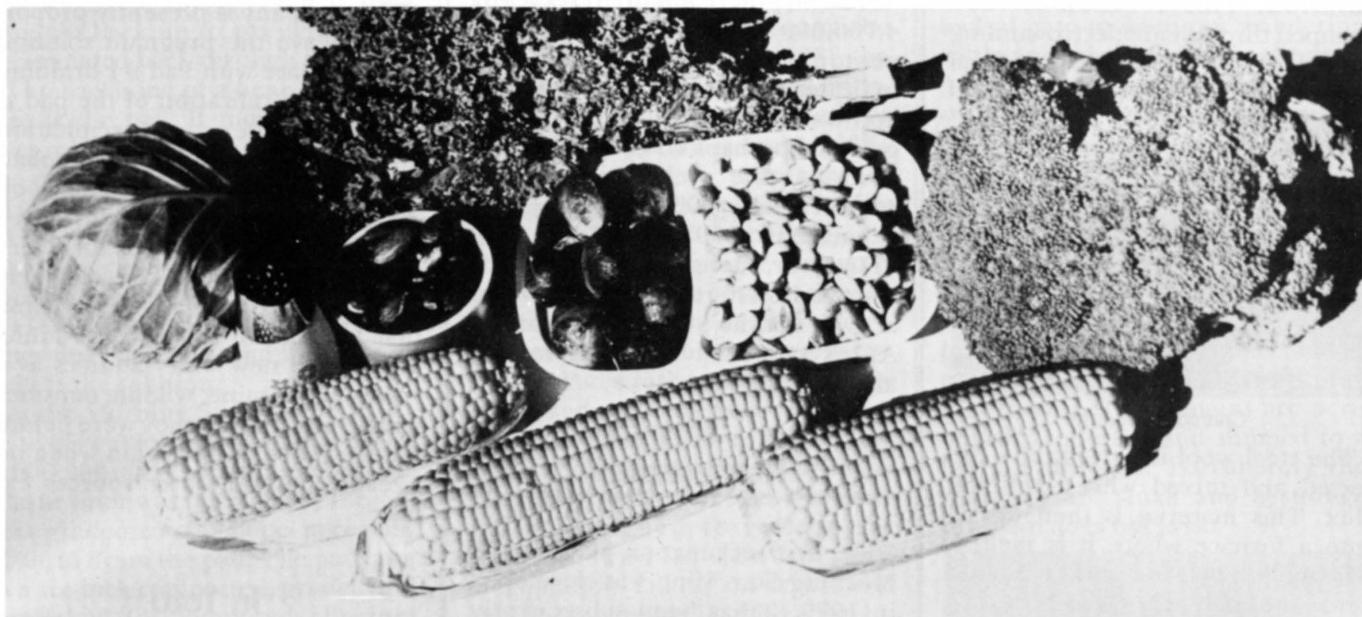
The annexed highly useful Implement, or Pick, was patented by the gentleman who heads this paragraph, in March, 1859. Mr. Emerson manufactured in the city of Sacramento, these Picks, until the 1st of July, 1859, when Messrs. Emerson & Jones disposed of their patent-right for the United States, to Messrs. Nelson & Doble, of this city, by whom the "Pacific Tool Company" has been established. (See advertisement in another column.) We learn that up to May, 1869, over 300 dozen of picks have been disposed of by them. This firm employs quite a number of hands, who have gained considerable experience in the manufacture of these tools. They have received orders from Oregon, Utah, and the Washoe mines, which serve as a proof of the satisfaction which these picks give. Messrs. Nelson & Doble have received from the Committee of the last State Fair, a very high recommendation accompanied with a silver medal. For further particulars we refer our readers to Messrs. Emerson, Nelson & Doble, 89 Pine street, in this city.

EMERSON'S PATENT MARCH 29, 1859.

EMERSON'S PATENT MARCH 29, 1859

ENVIRONMENT

Cyanide in the Environment



Corn, salt, cabbage, kale, almonds, brussel sprouts, lima beans, and broccoli; a few natural sources of cyanide.

By Marion F. Ely II, M.S.

Cyanide in the Environment?

Yes.

We live in an environment, no matter where we are, that contains cyanide.

How can this be?

Cyanide is a natural compound.

In the right amount, cyanide can be toxic. As is the case with salt, aspirin, vitamins and other substances which can also be toxic, it is the level of administration that determines its toxicity, *not* its innate nature.

In water cyanide forms an equilibrium between two free cyanide species: ionized cyanide (CN^-) and molecular, highly volatile HCN gas.

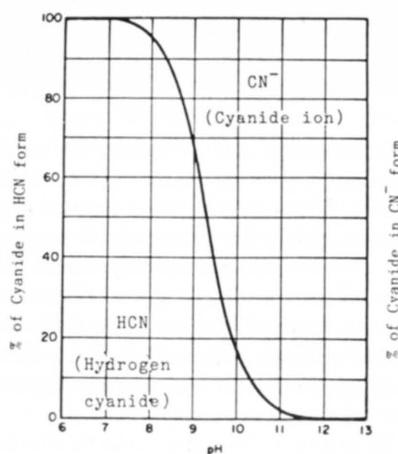
The environment is sprinkled with cyanide

The formation of HCN varies with pH, cyanide concentration and temperature. At a pH of 7 or less, nearly all of the cyanide is in the HCN form. Unless otherwise noted herein, the species noted as free cyanide is the ionic (CN^-) form.

We live in an environment sprinkled with cyanide. Fortunately, most of the cyanide we come in contact with is normally found in small amounts. When taken into the body by either ingestion or inhalation,

which is then excreted through the kidneys into the urine.

Cyanide does not bio-accumulate in the food chain



The effect of pH on the disassociation of cyanide.

tion, cyanide is rapidly picked up by the blood and transported to the liver. Within the liver cyanide is converted to thiocyanate (SCN^-),

Rats, however, although widely used for testing toxic substances, are not reliable indicators when it comes to cyanide. Rats fed for over two years with food containing two to five times the lethal dose of cyanide for a human showed no signs of cyanide toxicity, hematological or pathological evidence of adverse effects.

Cyanide does not bio-accumulate in the food chain and is not mutagenic, teratogenic or carcinogenic. The present drinking water standard of 0.2 mg/L incorporates a safety factor of 21 times.

The very feature of cyanide which makes it useful to society, i.e., its chemical activity, works to remove it from the natural environment. The environmental effects on cyanide are so marked that free cyanide is considered a transient pollutant.

UNITS OF MEASURE

mg/K: A measure of concentration measured in milligrams per kilogram.

mg/L: A measure of concentration expressed in milligrams per liter.

pH: The chemical measure of acidity or alkalinity of a solution measured on a scale of 0-14. Acid range: 0-7, alkaline range: 7-14; neutrality is 7.

ppm: A measure of concentration measured in parts per million.

Urban Exposure

In urban settings, hospitals are the greatest producers of non-industrial cyanide wastes. These cyanide wastes are produced during lab tests performed for hemoglobin and uric acid determinations. In Buffalo, New York, one 930 bed hospital discharges 930 grams of cyanide per year. It has been estimated that the Buffalo hospitals discharge over 5.6 kilograms of cyanide wastes to the environment each year.

The major source of human exposure to cyanide occurs through the inhalation of cigarette smoke. Very high levels of cyanide have been measured in cigarette smoke. In fact, in industry, cyanide detectors are often tested by employees who blow cigarette smoke into them. A second source of cyanide found in the urban environment is produced by automobile catalytic converters. The burning of plastics such as polyurethane also produces cyanide(HCN).

Domestic Exposure

Within the home, potassium cyanide is used as an ingredient in silver polish. Cyanides are uncommon in U.S. water supplies but are present in the kitchen where they are found both on and in foods and in the cooking atmosphere.

Sodium ferrocyanide (which is found in mining wastes), is used in amounts ranging from 50 to 250 mg/L to prevent caking and clumping in salt. The FDA regulations set a maximum limit of 13 ppm of sodium ferrocyanide in table salt. Sodium ferrocyanide (also known as yellow prussiate of soda), is very effective in this use. Since salt is a

common ingredient used in food processing, sodium ferrocyanide is found in bread, breakfast cereals, natural cheeses, meat and salad dressings. The average daily amount of this cyanide compound consumed by the American public has been estimated at 0.6 mg, well below the 1.5 mg level considered safe.

Due to the widespread presence of cyanide use in the food industry, the Environmental Protection Agency has established permissible levels of cyanide residues on foods. These cyanide residues range from a high of 250 ppm on spices, through 75 ppm on grains, 50 ppm on citrus, and down to 25 ppm on dried beans, nuts and cocoa beans.

for a unique experience that will take you out of this world...

**Cyanide in the kitchen**

Cyanogenic compounds are found in a variety of naturally occurring molecular forms in plants. One of the most common are **glucosides**. They **hydrolyze** to the less toxic thiocyanates (SCN) and are found in vegetables such as the Burpee white radish, Champion radish, cabbages, kale, Brussels sprouts, cauliflower, broccoli, kohlrabi, turnips, rutabaga, horseradish, Ethiopian rapeseed, Indian or brown mustard, black mustard, white mustard and charlock.

The greatest source of cyanide in the kitchen originates on the range while cooking. Many plants and foods contain naturally occurring cyanide and other substances, which, when hydrolyzed through the cooking process, release cyanide (HCN) into the atmosphere. Plants containing cyanogenic glucosides release cyanide during both preparation and cooking. These compounds are found in sorghum, lima beans, tapioca, cherries, almonds, macadamia nuts, bamboo shoots, corn and stone fruits.

Exposure in Nature

Interestingly, cyanide and its formation/consumption is an active form in the chemical processes of life. There are at least 16 varieties of bacteria found in nature that produce cyanide (HCN). One of these is found on humans and yet another is found in the forests on the white cedar.

There are over 30 fungi which also produce cyanide (HCN). What is commonly called 'snow mold' on alfalfa and other forage plants is produced by an unidentified fungus which also produces cyanide.

Free cyanide is not found in the higher plants. Many, however, contain cyanogenic glycosides which produce cyanide (HCN) when hydrolyzed. These compounds have been identified in over 1,000 plant species comprising 90 families and 250 genera. Although some plants contain what are known as cyanopyridine alkaloids which contain the cyanide group, they do not release cyanide.

It is believed that the sorghum plant is root disease-free because of the release of cyanide (HCN) from its roots. This release has been measured at 0.005 to 0.02 mg/24 hours per plant. Sudan grass reaches a maximum cyanide content of 2500 ppm in only seven days after sprouting from the soil. The cyanide content decreases as the plant matures and in 15 weeks has declined to around 250 ppm.

Livestock deaths caused by cyanide poisoning are attributed to the com-

mon vetch, lupine, grain sorghum and both Sudan and Johnson grass.

At least one insect, commonly known as the millipede, secretes cyanide (HCN) as a defense mechanism.

Due to the integration of cyanide in biological processes, it should not be surprising to find it in plants. The levels of course would be expected to vary depending on what part cyanide plays in the plant's metabolism. The California juniper contains 5.8 mg/kg. The ubiquitous Joshua tree 14.5 mg/kg and the Mojave Yucca 9.9 mg/kg. Shrubs also have cyanide lurking within them: Bladder sage 17.9 mg/kg and the popular shrub from which a tea flavored drink is often made, Mormon tea 12.1 mg/kg (the cyanide is destroyed/released in brewing).

Even desert soils have been found to contain measurable amounts of cyanide: 0.1 ppm.

Industrial Exposure

Until recently, the greatest consumer of cyanides was the chemical industry where it is used in the production of fibers, plastics, and as a high temperature fuel, and in pharmaceuticals. With the increase of gold and silver prices in the early 1980's, the renewed interest resulted in the mining industry becoming the major cyanide consumer.

Millions of pounds of cyanide used in the last 100 years

The electroplating industry is considered to be the greatest source of wastes containing high levels of cyanides. The liquid wastes that are normally created by electroplating for example, contain 15% free cyanide and a 10% mixture of ferrocyanide and ferricyanide plus traces of nickel and zinc. The waste slurry generally contains approximately 20% sodium ferrocyanide, 2% zinc, insoluble

material and about 50% water.

Mining Exposure

Of late there has been considerable interest in gold and silver mines and in the use of cyanide and its effects on the environment. Contrary to a popular misconception, cyanide has been used by the mining industry for nearly a century. Many examples cited as abuses are unfortunately steeped in ignorance of cyanide's properties and use. Although often

pH of Common Substances

0	battery acid
1.7	toilet bowl cleaner (acid)
2	lemon juice
3	vinegar, grapes, colas
3.5	kiwi fruit
4	tomato juice, yogurt
4-4.5	average acid rain
5	boric acid
5.5	cottage cheese
5.6	normal rain
7	neutral,distilled water
7.5	milk
8	baking soda
9	borax
10	household bleach
11	ammonia
14	household lye (NaOH)

sincere and misinformed, emotional issues generally are the motivational force to their objections. Literally millions of pounds of cyanide has been used successfully throughout the world during the last century without catastrophic consequences. In South Africa, for example, people have lived on cyanided tailings (they were moved when the tailings were reworked to recover residual gold).

Cyanide was first used in mining in the last century when it was discovered that weak solutions could dissolve both gold and silver. Being especially good in treating low-grade ores (less than 0.1 ounces of

CHEMICAL SYMBOLS

C: carbon.

Ca: calcium.

CaCO: lime.

CN: cyanide ion.

CO₂: carbon dioxide

H: hydrogen.

HCN: hydrogen cyanide (gas).

N: nitrogen.

Na: sodium.

NaCN: sodium cyanide.

NaOH: sodium hydroxide, (caustic soda).

O: oxygen.

S: sulfur.

SCN: thiocyanate.

gold per ton), cyanidation is the method of choice. It has a long and successful history of use and an enviable safety record in industry. In nearly a century of use as a routine industrial process, record searches have found no known provable fatalities from its application. (There have however, been suicides and lab accidents due to carelessness.)

As noted earlier, the majority species of free cyanide (CN⁻ & HCN) is determined by pH. At a pH of 7 or less, nearly all of the cyanide is in the HCN form. The pH, therefore, must be kept high in order to avoid toxic HCN fumes and to maximize the workhorse ionic form (CN⁻), typically a pH of 11+ is maintained, about that of ammonia. This high pH is attained through the use of lime (CaCO) or caustic soda (NaOH), commonly known as lye.

In the recovery of gold and silver from ores, a working solution is made from sodium cyanide (NaCN). The solution strength is commonly about 0.05% (500 ppm). The working strength solution sometimes is near 1% due to what is known as cyanacides, which remove cyanide, in the ore itself. Such offenders are copper minerals and ferrous sulphate. When applied to the ore, the strength of a cyanide solution rapidly decreases as compounding with other metals occurs. The free cyanide concentration is further reduced as the removal of gold and silver from the ore proceeds. Environmental factors such as bacterial action, further reduce the cyanide levels. As much as a tenfold reduction of free cyanide levels (500 ppm to 50 ppm) can occur.

Since the cyanide solution contains the precious metals, it is circulated

through closed systems that are monitored to detect a leak if it should occur. A loss of solution is a loss of gold, silver and money.

When the process has reached the point of diminishing returns for any given amount of ore, the ore is washed with water until no free cyanide is detected. This washing process can generally remove the free cyanide from a heap within 30 days. This has been the method used since the introduction of the cyanide process nearly a century ago when, after the tails were washed, they were disposed of onto land. Literally millions of tons of tailings were disposed of in this manner without problems. If an acceleration of the neutralization process is desired, sodium or calcium hypochlorite (common bleach) is circulated through the system.

Environmental Cyanide Degradation

The cyanide ion (CN^-) is useful because of its very high level of chemical activity. This very activity when exposed to the environment leads to its neutralization through degradation. In 1979 it was recognized that natural environmental processes play a major role in the degradation of cyanide. Important Canadian studies identified seven basic mechanisms which operate to destroy free cyanide: photodecomposition by sunlight, acidification by CO_2 in air, oxidation of O_2 in air, dilution, complex-formation, adsorption on solids and biological action. These natural degradation mechanisms were found to reduce the cyanide content by 99.9%.

Perhaps the most important mechanisms are those that produce volatilization. Sunlight, acidification by CO_2 and oxidation by O_2 result in the release of HCN to the atmosphere. Being highly volatile and lighter than air, the small amounts of HCN produced by mining processes are quickly dissipated and diluted by the atmosphere where it is destroyed. Given the low concentrations of cyanide used in mining, the potential amounts of HCN are also

low. In recent tests over pregnant ponds, cyanide detectors had to be almost in contact with the surface of the water in order to detect anything.

The complex-formation of cyanide with metals is a potent destruction technique. The insoluble compounds that result when iron is present (the rule rather than the exception with most ores), are ferricyanide and ferrocyanide. When exposed to sunlight, the insoluble ferricyanide is rapidly decomposed by the ultraviolet light. CO_2 and N_2 are released during this decomposition along with small amounts of HCN which is quickly lost to the atmosphere. During a Canadian summer the half-life of this process is 20 minutes and in the cooler fall, 50 minutes.

As is apparent, the destruction of cyanide is a function of temperature and wind. In a 50° F. environment, the half-life of cyanide is 60 hours, with a wind, 30 hours. At a temperature of 77°F., the half-life is reduced to 25 hours and 12½ hours with a wind.

Natural degradation reduces cyanide content by 99.9%

The adsorption of cyanide on solids and the effects of biological action are often combined. The percolation of cyanide solutions through soil columns has been shown to remove 90-95% of the cyanide. Some bacteria, fungi and algae consume cyanide. Many, if not all, plants have the ability to metabolize cyanide.

In the cyanide destruction process, bacteria produce carbon dioxide (CO_2), ammonia (NH_3) and nitrogen (N_2). In situations where cyanide discharges occur, bacteria concentrations have been noted. Some bacteria have been found capable of living in potassium cyanide (KCN) saturated solutions. In an anaerobic (without oxygen) environment N_2 is the major gas produced whereas in an aerobic

(oxygen containing) environment the cyanide is converted by bacteria to nitrate.

Cyanide Exposure Risk

Cyanide is widespread in the environment and is inhaled and ingested regularly every day. We are exposed to both species of free cyanide from cigarette smoke, automobile exhaust fumes, on and in our foods, in our kitchens and in the work-place. Plants metabolize cyanide and bacteria feed on it, some release it, even while on our bodies. When our systems are exposed to environmental cyanides, the liver readily converts cyanides to the far less toxic thiocyanate which is safely excreted through the kidneys.

Although cyanides are ubiquitous, cyanide levels in the environment are low enough that they are easily handled by most life forms with the exception of hungry cattle. There is no evidence of cyanide biomagnification within the food chain. Toxic levels cannot therefore be attained. This is because low doses are rapidly detoxified by most species, and large doses result in death. Cyanide cannot, therefore, be considered a persistent pollutant. The environment is a threat to the presence of cyanide, not vice versa. Strange as it may seem, cyanide is a part of life.

MINING COUNTRY ADVENTURES

Calico Ghost Town: A Place to Remember

By Linda Mikels

Recapture the flavor of the Old West in a quiet canyon, midway between Los Angeles and Las Vegas. Calico Ghost Town, located just 10 miles north of Barstow, California, provides a rich and unforgettable experience that thrills its visitors all year long.

Between 1881 and 1896 Calico was the largest silver mining camp in California producing, by some estimates, a total of \$86,000,000. in silver. By 1896 the population had soared to about 4100, but when the mine closed, Calico became a sleepy ghost town. Then in 1950 Walter Knott restored the old town which would soon become one of San Bernardino County's best loved regional parks.

Calico Ghost Town is open from 7 A.M. to dusk every day except Christmas. The shops and restaurants are open from 9 A.M. to 5 P.M. Although there is a \$.4. per car parking fee, admission to the park is absolutely free, and the adventure begins the moment you arrive.

As soon as you step out of your car, you will want to head straight for



The Calico Tram

Main Street. You may choose either to take the Cable Tram for a dollar (\$.50 after 4 P.M. and children under 6 ride free) or to climb the 109 rugged steps up the hillside a fair aerobic workout. If you don't wear comfortable walking shoes, you will never forgive yourself.

Main Street takes you back in time

Your first step onto Main Street will make you feel as if you have

gone back in time. The street is lined with old buildings and creaky wooden sidewalks. Wagons, water carts, and a rusty old safe (Diamond Lil's Purse) all add to the Old West ambience.

Perhaps you would like to start your day with a delicious breakfast at the Calico House Restaurant. Enjoy the western decor and relax in those creative contoured wooden chairs. Don't forget to check out the interesting light fixtures overhead (Knott's pie tins around a wagon wheel). The Calico House Restaurant also features both a lunch and dinner menu, so you might decide to finish your day right back here again.

Calico is a great place to do some serious shopping, but before you start, you might want to visit the museum just up the street. You'll see an old phonograph, an 1854 Wheeler and Wilcox sewing machine, several old cameras, an "ancient" typewriter, and even an old zither. Best of all are the life-size replicas of a typical Calico kitchen, a blacksmith shop, and a tonsorial parlor where you could get a haircut and a tooth extracted at the same time.

Right behind the museum is the old Maggie Mine. Don't miss this oppor-



The Maggie Mine



The Calico School

tunity to sense first-hand what the life and work of an 1880's miner was like. The walk-thru tour is only \$1.50 for adults and \$.95 for children. It leads you to the Glory Hole which alone produced an estimated \$65,000 in silver during its three short years. By the end of the tour, you will very likely be impressed with what hard and dangerous work mining at Calico must have been.

The Calico and Odessa Railroad provides another opportunity for the tourist to see the mining operation up close. For only \$1.50 for adults and \$.95 for children, you can travel around the hills above the town and gain another perspective on mining at Calico. Then as you head back to Main Street to do some shopping, notice the house made entirely of bottles which have been cemented together!

Born to Shop?

If you were "born to shop" you'll love the shops at Calico. But even a casual browser can enjoy seeing the wonderful items for sale. Visit Granny's Calico Crafts and enjoy the scent of potpourri that greets you as you walk in the door. Notice the huge selection of hand-crafted items placemats, appliance covers, tissue covers, photo albums, dolls, and

even Christmas ornaments. It's the perfect spot to find that special gift for a friend or that special something for your own home.

Across the street you'll find the Leather Works with everything from sand paintings to souvenir trinkets. Don't miss the exquisite leather jackets, vests, hats, and boots. If your children are into cowboys and Indians, you won't be able to leave without purchasing a tomahawk or perhaps a headdress.

Lane House Needlepoint, just up the street, is located in the old post office and courthouse building; which later became Lucy Bell Lane's home from 1920-1965. The shop is full of lovely needlepoint and crewel kits which are especially popular with Australian tourists who can't find such kits in their homeland. When you finish your shopping here, be sure to tour through the charming home which displays some of Lucy Lane's very own furniture. Lucy was always known for her hospitality, and the warmth of her home still lingers in every room.

At this point in your day, you will certainly need a lunch break. Why not stroll to the end of Main Street to the Top of the Hill Confectionery, owned and operated by the Fikstad family? Order one of those big hot dogs and a bottle of **sarsaparilla**. But take a moment to chat with son, Darrin, the manager. English isn't the only language he speaks. Large tour busses come through each week with

German, Italian, French, and Oriental visitors. Darrin enjoys conversing with them in their own native tongue. If you can afford the calories, stay awhile and have a delicious ice cream sundae. Then just before you leave get some of that old-fashioned candy to take home.

Just up the hill past the confectionery, you'll notice the restored Calico schoolhouse. Cross the old wooden bridge that stretches over a ravine and take a peek inside the one-room school. It looks much like the school that Laura and Mary attended in "*The Little House on the Prairie*." There are those wonderful old desks with seats that flip down for the student in front, the potbellied stove, and even original McGuffey's Readers. You can almost hear the crack of a ruler over some naughty child's knuckles. Linger awhile and imagine what education must have been like in the late 1800's.

Schoolhouse complete with McGuffey's Readers

Undoubtedly you will want to get on with your shopping, and there are many more shops left to see. The Basket Shop carries not only a wide variety of interesting baskets, but also a wonderful selection of candles. The 3 foot tapers might add an especially lovely touch to your home. In addition to the baskets and candles, the shop sells a huge collection of books.



Lane's General Store



The Bottle House

tion of silk fruits and vegetables. Artichokes anyone?

Right next door is the Spice Shop filled with the aroma of coffee beans, teas, and spices. The proprietor here, Mr. Fikstad, (also a partner in the Top of the Hill Confectionery), will enjoy showing you the collection of West German mugs and the Mamma Ro demitasse sets from Italy. If you are looking for a coffee grinder or an espresso coffee maker, he carries those too. Take the time while you are there to look at the glorious array of spices. Have you ever seen whole nutmegs before? He even has those on hand. Mr. Fikstad told us that he ships items to people all over the country. A popular item is his stock of Boarding House Seasonings. Next time you make meat loaf, why not try his famous Miner's Meat Seasoning? It's great!

At this point in your day, you will surely be talking about coming back to Calico. It is really hard to see everything in one day even though it is just a small town. You still must see the Calico Pottery Works with its Indian pottery, wind chimes, stained glass, painted tiles, and dinnerware; the R&D Company Store with its souvenirs, toys, and original paintings; and Calico Print, overflowing with historic literature, posters,

maps, recipe books, copper art, coo-coo clocks, and even Christmas items.

Free ore samples

If you would like to take home a free sample of silver ore, stop by the Calico Rock and Gift Shop. You can also find there a number of other rock samples and a gold panning kit. You geology buffs will love this shop. There is a wonderful collection of fossils for sale and a magnificent display of **geodes** from all over the world. The polished rock book ends and the Ray Lamb pewter sculpture are terrific gift ideas. In addition to all this, you'll enjoy the lovely selection of jewelry.

Be sure to visit the 1890's Store with its antique replicas, brass items, porcelain dolls, and dainty lace doilies. Then finish your spending spree at Lane's General Store. They carry everything from hats to T-shirts to old-fashioned women's apparel to stuffed animals. Maybe it will be that candy counter that will catch your eye. There are many souvenir and gift items to choose from as well at Lane's General Store.

Hopefully you will find the time to include some entertainment in your day at Calico. You can visit the Mystery Shack (\$1.25 for adults and \$.95 for children) and experience what they accurately call "optical untruths". Does water really flow up? Find out for yourself at the Mystery Shack. Then you might want to see what's happening at the Silver Bowl or visit the Shootin' Gallery. For one dollar you

will get 12 shots to make all kinds of things happen in an old western saloon setting. See the gun-fighters draw their guns and the barmaids dance.

But your day would

not be complete if you didn't take in an old-time melodrama at the Calikage Playhouse (\$1.75 for adults and \$1.00 for children). Cheer for the hero, boo the villain, and sigh when you see the fair maiden. Whatever you do, don't just sit there and watch. Join in and have some fun. From Memorial Day thru Labor Day at 7 p.m. the Calikage Playhouse will be presenting "Sweet Nell in Distress" as a special engagement. Tickets are \$3.95 and the evening includes sing-a-long **olios** and 1880's frolickin' fun.

Special Events

Calico Ghost Town sponsors a number of special events throughout the year. In March you can spend a weekend at the Calico Pitchin', Cookin', and Spittin' Hullabaloo. Then in May you can plan to attend the Calico Spring Festival which is an old-time Bluegrass hootenanny. Calico Days in October is a celebration of Calico in its glory days and includes the National Gunfight Stunt Championships. Finally, the Fine Arts Festival is held every year in November featuring the West's foremost artists.

Why not plan on a day or a weekend at Calico real soon? There is adequate camping available if you plan to spend the night. Just call (619) 254-2122 for reservations. The entire family will have a delightful time, and it will be an experience you will want to repeat again and again. See you there!



The Calikage Playhouse

MINING DISTRICT

The Calico Mining District, Part I



Miners from the Occidental Mine, ninth level (note candle wax on their pant legs.) Front row: Walter Oliver, Willie Warren, James O'Brien, ?, Dan Malloy, ?, ?, ?. Second row: ?, Captain Bryxon, Swan Olson, Mr. Friedlander, Bill Ried, Jim Jullian, ?. Top row: Gus Hoban, Matt Phillips.

By Marion F. Ely II

The reconstructed "Ghost Town" of Calico is one of the most popular tourist attractions in Southern California. As such attractions go, it is unique in being on the same ground where it was originally constructed and the mine dumps can be seen from the main street of Calico. In Part I, we look at its early days. In Part II, we will look at the people and latter days of Calico.

In order to show comparative values, current silver values calculated at \$5.00 per ounce are shown in brackets: [\$].

Once upon a time...

Some 12 million years ago, during the Miocene Epoch, the region sur-

rounding the present location of Barstow, California, was a fresh green, rolling landscape of moderate relief. Deciduous hardwood forests covered the higher elevations while the lower countryside contained trees typical of those found presently in humid areas within 2000 feet of sea level. Streams and rivers passed through grassy fields, feeding lakes of varying size which punctuated the landscape. Herds of small horses barely 40 inches high roamed the land along with antelope of similar size but possessing four horns, one pair of which resided half-way down its snout. Shading themselves under palm and other trees were the slightly larger camels and small four-

tusked mastodons, giraffe-camels, and wild pigs with skulls four feet long. Stalking all were the saber-toothed cats. Other strange animals, with bizarre appearance and names and with no known modern counterparts, completed the menagerie.

This was also a time of volcanic activity which occasionally pierced the placid Eden-like terrain. Forces within the earth's crust were slowly beginning to change the topography and more importantly, the chemistry, mineral content, and nature of the rocks below. Ample precipitation provided by the humid climate carried erosion products to the lowlands and lakes. As the topography continued to change, drainage patterns were altered.

Lake sediments and eruptive volcanic products were being buried, faulted, shattered, twisted, and **metamorphosed**. These invisible forces within the earth's crust alternately pulled, compressed, slid, and lifted the subsurface into the atmospheric arena. Exposed to the elements, the rocks and the minerals they contained would be attacked by water and oxygen.

As faults intercepted **magma chambers** deep within the earth's crust, released gasses and **hydrothermal** fluids under tremendous pressures were tapped. These constituents of magma forced their way toward the surface through the faults and associated fractures. Over thousands of years the ascending liquids and gasses circulated through these subterranean conduits and, in some places, passed into lake sediments.

As these solutions cooled, various minerals precipitated out of solution and became residents of the fractures and fissures created when fault **wall-rocks** were moved apart. In some places these gasses and hydrothermal solutions attacked the rocks containing them. New rock minerals and clays replaced large volumes of rock along some faults.

The solutions contained chlorine, bromine, barium, sulfur, and metals; the more important metals were silver, iron, copper, lead, zinc, and infinitesimal amounts of gold.

Over the next 12 million years or so, forces within the earth's crust raised mountains containing these deposits. The humid climate continued, deeply eroding the mountains and exposing the mineral deposits to the atmosphere. However, the ice ages which followed slowed this process. The climate continued to change through time, and about 11,000 years ago the region became a desert.



The 60' wide Mammoth stope in the Red Cloud Mine. James Mulcahy is drilling the lower hole while Harry Livingstone drills the upper. Matt Phillips sorts the ore while Steve Rorve mans the shovel. Note the fault plane that dislocates the ore body behind Harry (his pick handle points to it.) The ore minerals are the dark patches.

HARDROCK MINING— HARD WORK!

The advance of underground workings is never easily achieved. Until the advent of mechanical drills in 1852, all drilling for explosive placement was accomplished by hand. Progress was slow and hard-won. How fast the holes were drilled depended upon the type of rock, the direction (up, down, sideways), and the drill-pattern used. Most important of all was the skill, strength, and stamina of the miners themselves. Mining was (and is) a serious business.

It was not unusual for daily progress to be measured in inches. On average, two men could make two to four feet—*per 10 hour day*. It should come as no surprise then, that what seems to us to be small advances, were really significant. This also explains why the man-power requirements were high in this labor-intensive industry. The greater the population, the greater underground workings they produced.

A Man Named Silver!

In the 1870's, Lafayette Mecham operated a small store at a place called "Fish Ponds" east of Barstow, California. One day an Indian stole one of his horses and headed north into what was the rugged mountains called Calico. Mecham mounted another horse and followed in hot pursuit. While in the mountains, he saw some red iron **gossans** capping what he thought might be mineral deposits. He did nothing about what he saw beyond urging his oldest son Frank to check it out. He didn't.

An eccentric old man known as Lee found what he believed to be a quicksilver mine north of Barstow. After poking around the **vein** for a while, in 1879 he disappeared on a prospecting expedition into the eastern Mojave Desert. He was presumed dead.

In 1880 the site of Lee's quicksilver (mercury) mine became the very profitable Waterman Mine. Lee had somehow confused the brilliant particles of native silver in the vein for quicksilver. Between 1882 and 1887 the Waterman Mine produced over 1.5 million ounces of silver worth

\$ 1 , 7 0 0 , 0 0 0
[\$ 7 , 5 2 2 , 0 0 0]. Hundreds of locations were made in the immediate vicinity until, it was said, "...not a red rock remained but is well monumented."

Happy New Year!

The interest in silver became intense and prospectors began spreading out into the surrounding area. East of Waterman's Station (now called Barstow), California, in the Calico Mountains, an historic event occurred on New Year's Day,

1881. Just north of where the town of Calico would rise, Lowery Silver located his Consolidated claim. It was followed on the 7th by the Sara. On February 8, he located the Silver Mill Site and on March 3, the Pico.

Further west, Sheriff John King and a group of men were prospecting around the new Waterman Mine. A trio consisting of Frank Mecham (Layfayette's son), George Yager, and an undersheriff, Tom Warden, left the group and traveled east and entered the Calico Mountains. They found a large gossan-capped formation that jutted up out of the ground. It ran northwest along the base of the cliff that marked the nearly sheer south side of what later became known as King Mountain.

On April 6, 1891, Warden located the Silver King Mine. He later claimed to have intended to locate the standard rectangular 600 by 1500 foot mining claim on the steep terrain. In fact he had

located a truncated triangle covering only 7.25 acres instead of the 20 acre claim the 600 by 1500 foot area would have covered—a serious oversight as later legal battles proved.



Loading an ore car from a chute which reaches the workings above. (Note the miner's candlestick in the wall behind him.)

The group took samples from their claims and had them assayed. Some showed only a trace and others up to one or two ounces of silver per ton; some ran slightly higher. Their value averaged one to two dollars a ton with the best being worth about eight dollars per ton—nothing to get very excited about.

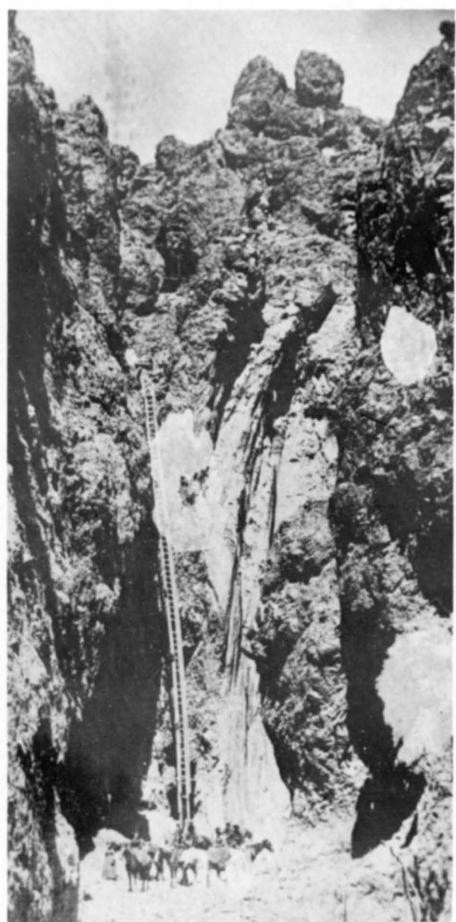
On June 25 or 26, Mecham's brother, C.L., returned to the Calico Mountains with Huse Thomas and Huraneous Hartman. They camped in what later became known as Wall Street Canyon. The next morning C.L. and Thomas started additional prospecting of the Silver King claim. Carrying a pick with him, C.L. left Thomas to look at the east end of the **lode** while he climbed up the mountain to the west end of the claim. Reaching the top of the **outcrop** which marked the lode, he began walking along it to the southeast, knocking off chunks of it as he went, cogitating about what it might be worth. As the lode was as much as 40 feet wide, he meandered along looking for something interesting. One section of the lode formed a rather high cliff which he climbed. While breaking up samples

on top, he saw in the fragments what looked to him like sap blisters on a fir tree. Taking out his knife, he tried cutting them. It was like cutting a lead bullet. It was **horn silver**. Becoming very excited, he broke off many pieces across the outcrop. They all contained the soft "blisters". These were later called "bird's-eyes" by the miners.

When the trio returned the next day, they eagerly shared what they had found with the others gathered there. The rush to the Calico Mountains began.

The Early Days—Hard Work!

On May 27, 1882, the Calico Mining District was formed. Men continued to pour into the district from other declining mining districts. In July, the *Calico Print* newspaper began publication. With the district's fame spreading,



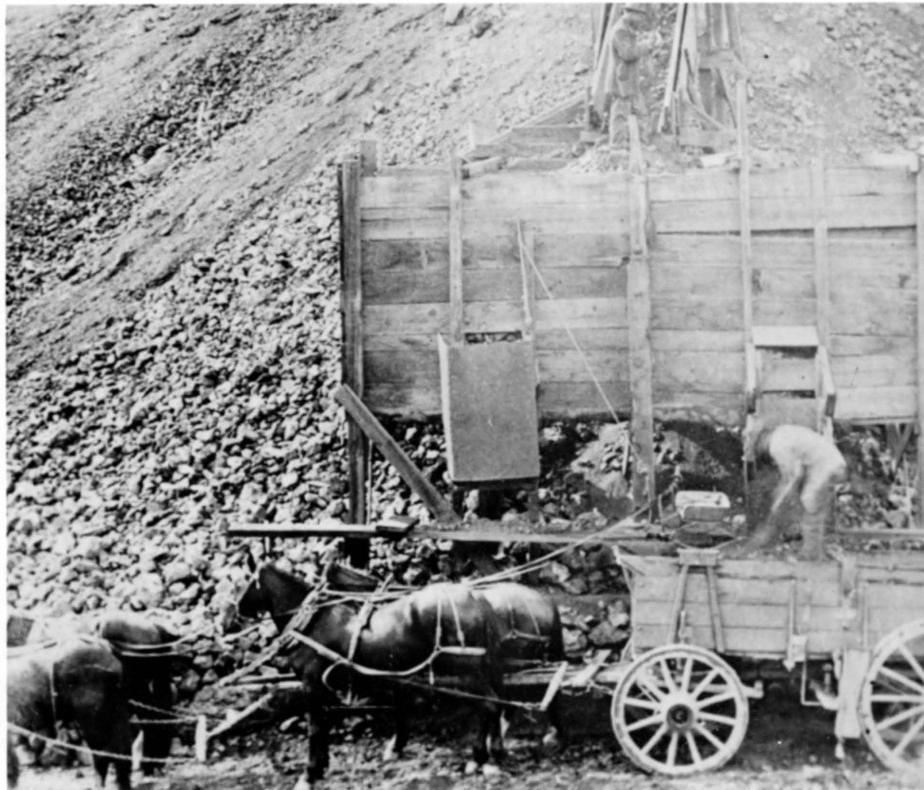
The 90-foot ladder in Wall Street Canyon leading to the Sue Mine. Up in the morning down at night!

CALICO: WHEREFORE THE WORD?

In 1498, Vasco de Gama, the noted Portuguese explorer, reached the end of his expeditions from Lisbon. After 12 months and two days on the high seas, he reached India. He landed on the coast of Malabar at an ancient port called, Kale Rhoda, "City of the Black Goddess". The name also extended to the territory surrounding it.

A cotton cloth was produced there that reflected the skill of the weavers and most importantly, was dyed in brilliant colors. It soon became a hit in Europe. In the seventeenth century the Dutch East India Company, in its usual business-like manner, investigated the possibility of producing the colored cloth in Holland rather than importing it from India. As a result of their success, by 1676 the colored cloth was introduced to the London market.

Long popular, the cloth took its generic name from its place of origin in India. Kale Rhoda became, by assimilation into European tongues, Calcut and more simply, Calico.



Loading a Mule Team Ore Wagon

even the distant *Tombstone Epitaph*, reported that by August of 1882 there were 300 people in Calico. Many of these men went to work on the Silver King Mine.

Early mining of the Silver King was unique in the annals of mining history. The outcrop of **ore** was so large and rose out of the ground so far that the miners had to literally tear it down. As a consequence, no tunnels or shafts were required until the outcrop was reduced to ground level.

The ore was placed in sacks and dragged down the mountain on top of rawhides. Later, tramways and wooden chutes replaced this system. The first carload of ore was shipped to San Francisco for reduction. The ore was rich—over 400 ounces of silver per ton were recovered at the mill. With silver being worth about \$1.13, the ore returned \$400-\$500 per ton [\$1770-\$2212]! However, it did not come easy.

These were the days before power drills. Holes for explosives were drilled by hand. A man would hold a drill with one hand and strike it with a four-pound hammer held in the other hand. The drill had to be turned so that it wouldn't stick or

jam in the rock; at intervals the pulverized rock was blown or scraped out of the hole. This process was called "single-jacking".

Two men could operate as a "double-jacking" team. In this case one man held and rotated the drill

while another swung a 10-pound sledge hammer to strike the drill.

Miner's Candlestick

All this work was often accomplished in a cramped and uncomfortable position. The pitch-black darkness surrounding the miners was brushed aside only by a candle held in a "**miner's candlestick**" which was stuck in a timber or a convenient crack in the rock. The candle would burn for about five hours before needing to be replaced—two candles per 10-hour shift were required. (The miners had to buy their own candles.)

The progress of a **mining district's** workings were an indicator to the outside world of its significance and whether or not those on the ground were intent on developing a mine. The size of the vein and its value were no less worthy of note. Some idea of economic significance can be estimated from the fact that payment of \$1 for a ten-hour day was a good non-mining wage in the 1880's.

In October, 1882 the *Calico Print* announced that the Four-Aces mine was down 35 feet on a one-foot vein that was **assaying** about 96 ounces of silver per ton (\$125)[\$480]. At the



The Silver King 20-Mule Team Ore Wagon in Wall Street Canyon (now the parking lot)

Dragoon Mine they were down 10 feet on an eight-foot wide vein that was assaying up to nearly 400 ounces per ton (\$400)[\$2000].

By Christmas the news was getting really exciting. The Garfield Mine was in a seven-foot wide vein that was assaying nearly 500 ounces per ton (\$565)[\$2500]. The Dragoon Mine was down 20 feet and into a seven inch vein that ran over 885 ounces per ton (\$1000)[\$4425]. Not to be outdone, the Boss Mine reported values over 1000 ounces per ton. The Silver Odessa was sold and was producing 10-12 tons per day.

If 1882 had been an exciting year, excitement grew to unbearable proportions in 1883, as the workings attained greater depths and more properties were developed.

What was to become the major producing mine of the district, the Silver King, was being rapidly developed. In January, 1883, there were five levels in the mine, one of which cut the lode 375 feet from its apex. The main shaft was down 90 feet, and five tunnels ranged in length from 18-150 feet. The ore assayed \$100 per ton [\$442], but mill returns brought only \$90 [\$398].

The Sue Beats the Best

The Burning Moscow Mine had a shaft down 140 feet. The Sam Houston Mine was developing a 28 inch vein that carried average values of \$202 [\$893] with portions having values of \$2000 per ton [\$8850]. The Gobbler was down 50 feet in an eight-foot wide vein. The Bismark had eight men working on a 50 foot shaft. A mine called the Best was down a mere 20 feet in ore running \$700-\$800 per ton [\$3097-\$3539]. The Bismark was producing an ore that was free-milling horn-silver at a rate of 110 ounces per ton [\$550]. The record was being held by the Sue Mine, which was in a four-foot wide vein assaying \$7000 per ton! [\$30,973] On February 20, the Waterloo Mine was discovered about one mile west of Calico.

By March the Silver King 100-ton ore bin was nearly full. The shaft was now down to 150 feet, and the mine

was producing 25 tons of ore per day. By July there were 3200 feet of workings in the mine and 55 men laboring in its depths. Pockets were found running \$1348 per ton [\$5965], but the average was still a respectable net of \$90 per ton [\$398].

Golcanda Ties the Sue

Employment in the major mines continued to grow. The Gobbler had 12 men, the Oriental had 25 men working on the 300 foot level alone, and Mammoth had 26 men producing 15 tons per day.

Ore values continued to rise. On the fourth level of the Oriental, low-class ores were only running \$200 per ton [\$885] while the better ore was as much as \$534 per ton [\$2363]. The Golcanda Mine tied the Sue with \$7000 ore [\$30,973], but more importantly, they were in \$900 ore [\$3982] containing wire silver. The Gobbler vein was 10-12 feet wide and produced a blue ore averaging \$200 per ton [\$885].

The Silver King was in a 2.5 foot wide vein averaging \$1280 per ton [\$5664]. The noted teamster, Remi Nadeau, hauled 60 tons of ore everyday from the Silver King Mine to the Oro Grande Mill. He used as



The Silver King Outside Chute and 100-ton Ore Bin

out, only impressive chambers remained.

Chloriders

With over 50 mines and many more claims in the district, many men were needed in this labor-intensive industry. Known as "chloriders", these men leased all but the major mines from their owners. Constant testing of the ore was a necessity because, under the physical constraints of the district (lack of fuel and water), the ore had to carry at least 40 ounces of silver per ton to be worth while because the "tribute" chloriders paid to the mine owners was 20%. The test was known as the "hypo".

The hypo test was made by crushing some of the ore into a fine powder and placing it in a test tube along with a solution of sodium hyposulphite (the "hypo"). The mixture was shaken for several minutes and then

some calcium sulphide solution is poured into the test tube. The quality of the ore was then judged by the amount of precipitate formed and the blackening of any undissolved horn silver. Although not a perfect test, it was widely used as a short-cut assay.

NEXT ISSUE: PART II: The Sound of Silver; Life in Calico

CHEMICAL SYMBOLS

Ag: silver.	Fe: iron.
Ba: barium.	O: oxygen
Br: bromine.	Pb: lead.
Cl: chlorine	S: sulfur.
Cu: copper.	Zn: zinc.

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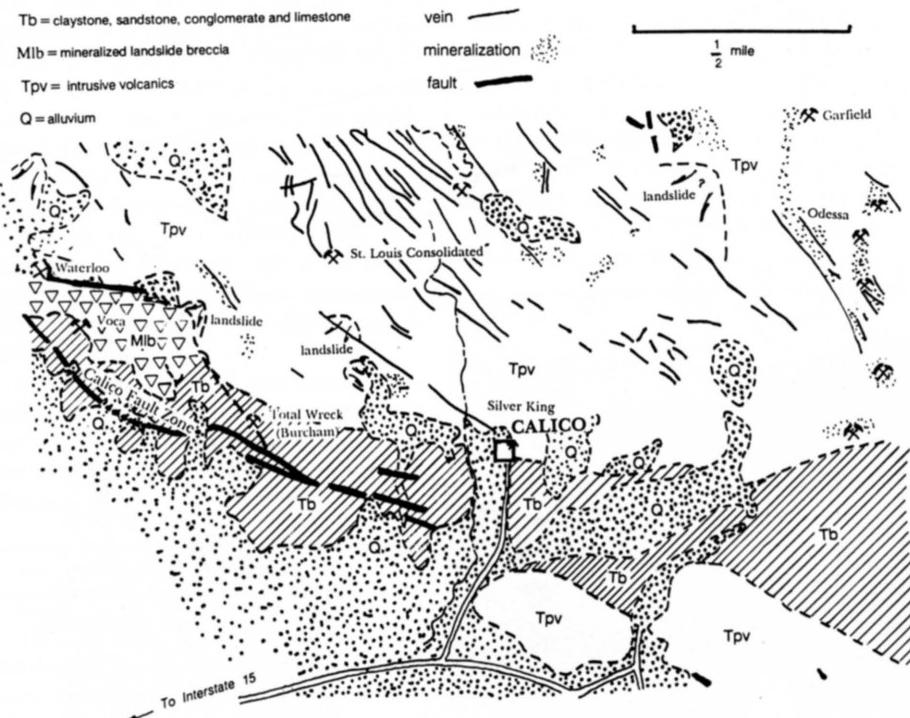
Hair sold at wholesale and retail; also, all articles used by Wig Manufacturers.

PAST TENSE: Calico

Fourth Annual Report of the State Mineralogist

"During the past two or three years a very extensive and promising silver field has been opening up in the Calico and adjacent districts, San Bernardino county; and while it is too early to pronounce upon the permanence of the deposits there, indications denote for this region mineral resources of no mean order. Thus far these mines have produced a total of five or six million dollars, and at a comparatively small cost. They have been almost entirely self-supporting, very little capital being invested either in opening up or supplying plant to the mines. The ores contain for the most part chlorides of silver, easily worked by crushing and amalgamation pans after the Washoe plan. The veins occur here of all sizes, though the majority of them are rather small. The ores which are found usually in streaks, bunches and chimneys, are of a high grade, and, in the claims worked, have been to hold from the surface as far down as developments have extended, between five and six hundred feet. There are now about 2000 miners in that region, the most of them working their own claims in a small way, the richness of the ores and the facility with which they can be extracted and disposed of rendering this practicable. At first the ores were nearly all shipped in small lots and marketed in Oakland and San Francisco; now the bulk of them is worked on the ground, the larger companies owning their own mills, of which there are five or six in the county, while the miners sell most of their ores to the custom mills, which samples and buys them. These sensible and business like methods having been adopted and adhered to from the first, mining has been kept in a healthful and progressive condition, these districts presenting the most satisfactory record of any in the history of silver mining on this coast. No other silver-bearing field has received so little outside aid, nor has any made such a steady and profitable production from the start."

Calico Print March 8, 1885



Geology of the Calico District (after Weber, CDMG)

SPOTLIGHT

The Silver Senator: William M. Stewart

Something very unusual happened in the U.S. Senate in 1872. A bill became law that was written by a senator with first-hand knowledge on the subject. The senator: William Morris Stewart. The law: The General Mining Law of May 10, 1872.

William Morris Stewart was born in a log house at Galen, Wayne County, New York, on August 9, 1825. The family had moved from Massachusetts to the 150 acre tract of land in New York on which he was born. Although they were harried by Seneca Indians, it was a defective title to the land which caused them to leave. When young William was seven years old they moved to the Mesopotamia Township, Ohio.

When he was 13, he ran away from home in order to get an education in Farmington. He excelled in math and taught school until 1849 when he entered Yale. The lure of the California goldfields gripped him and after borrowing \$500, in January, 1850, he left Yale for California. He sailed from New York to Panama where, by land, he crossed the isthmus to the Pacific. He arrived in San Francisco on April 7, 1850.

Arriving the goldfields around Nevada City he came down with Yellow Fever contracted in Panama. As his condition worsened, his friends thought he would die. They gave him a supply of bread and left him near a spring. After 10 days his fever broke. In regaining his health, his 6'-2" frame returned to its 200 pound weight, and the red-head continued the search for his fortune.

With only five dollars remaining from his original stake, he went to Buckeye Hill near the middle fork of the American River. Here his fortune took a turn for the better. In the fall of 1850, he discovered what became known as the Eureka Diggings.

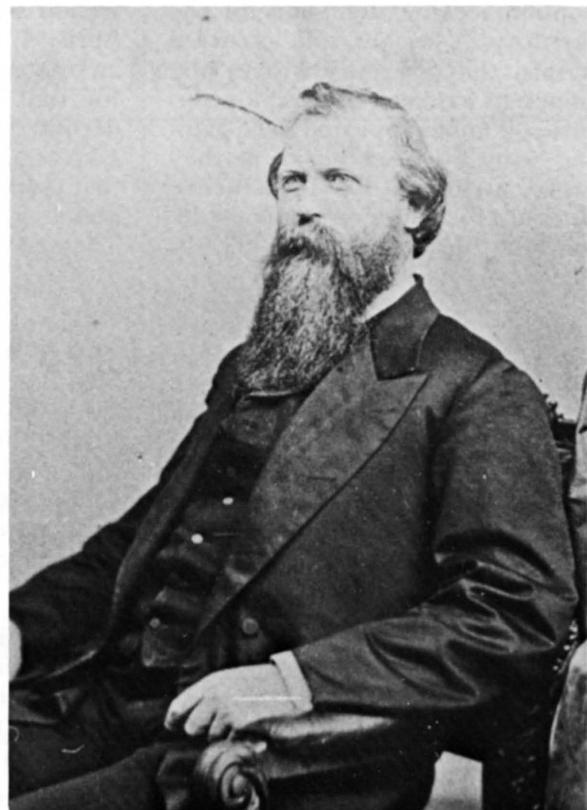
Utilizing his newly gained wealth, he built a flume and then a sawmill. His stature among the mining community grew along with his interest in law. He ran for sheriff in 1851 but was defeated. After studying law with an attorney friend for three months, in 1852 he passed the California Bar. His intelligent leadership was noted, and in December he was made chairman of a group forming quartz mining laws. (Lode mines were known as quartz mines since they followed quartz veins containing gold.)

He was appointed District Attorney in Nevada City. In his first case the opposing attorney called him a liar. Not liking this, Stewart knocked him out—in the courtroom! He was jailed for his effort.

With the discovery of the Comstock lode in 1859, Stewart became involved with its litigation at an early date. A dispute arose among the original discoverers, and he was called upon to settle the case.

In April, 1860, Stewart became a resident of Virginia City; more importantly, he became the attorney for the Ophir Mine. On July 10, 1860, the 36 year old Stewart, his wife, and daughter left California on mules for the Comstock. On September 12, he became the Carson County Prosecuting Attorney.

On April 17, 1861, he was appointed a county selectman. In May, he was elected a Trustee of the Presbyterian Church in Nevada. The purpose of the Trustee Committee was to find property and build a church in Carson City.



Collection of the California State Library

That same year he was elected member of the Territorial Council, District No. 3. His popularity was noted with 557 votes cast for him out of a total of 1095 in a three-way race. On August 31, Stewart became the state senator from Carson City.

In 1862, Stewart and his partners, John Henning, James Morgan, and C.F. Wood built a 12-stamp mill with a 30 ton capacity in Copper Canyon. A canal 15 feet wide and half a mile in length brought water from the Carson River to the mill. With water pressure from a 21 foot head, a turbine wheel seven feet in diameter and weighing 7000 pounds, powered the mill. Then the largest in the state, it was believed capable of operating 150 stamps. The mill was 160'x60'. The offices were in a stone building 30'x40'. Cost: \$50,000. They also owned 33 1/3 feet of the Gold Hill ground. In 1863 this mill became known as the Zephyr Flat mill.

Stewart's reputation continued to grow, and in 1863 he became a member of the Constitutional Con-

vention seeking statehood for the territory. A serious split occurred within the convention over the mines. As has been the case for centuries, if mines appeared to be gaining some favored position, they were attacked by legislation designed to reduce or eliminate the position. In this instance a tax was being proposed.

Stewart objected to the proposed taxing of mines, calling it an injustice, because, in words he was to use many times, it taxed the "...hopes of poor miners; his shafts and drifts and bed-rock tunnels". The proposal treated unproductive and productive mines equally. Even claims were to be taxed, "...on account of the value given to the location because of the present hope or belief that it would lead to value at some future time."

These positions did pose a substantial threat to the source of the state's wealth, and the people recognized it. It could have also jeopardized the important source of Union funding for the ongoing Civil War. Stewart's position struck a responsive chord with the populace; the proposed constitution was defeated, delaying statehood. The offensive language was removed in the second attempt.

Stewart's career continued its ascendancy. In 1864 he was elected to the first U.S. Senate from Nevada. A stalemate for the other senate seat was broken by Stewart, and James W. Nye accompanied Stewart to Washington. Two and four year terms were available for the senators. Nye drew the short straw, and Stewart captured the longer term. He held the position until 1876.

During his tenure in the Senate, and because of his legal experience with the silver mines of the Comstock, he became known as the Silver Senator. With this background he was asked, on short notice, to write the General Mining Law of 1866. He later rewrote and greatly improved it and in 1872 the new General Mining Law was passed.

During the early days of his term in Washington, D.C. he became

friends with Abraham Lincoln. On April 14, 1865 Stewart tried to get an appointment with the president for that evening. The President declined because he had promised to take Mrs. Lincoln to Ford's theater that night. Mr. Lincoln instead suggested they meet at ten the next day. That was President Lincoln's last day on earth.

Senator Stewart and Senator Foote of Vermont (his father-in-law) notified Vice-President Andrew Johnson later that night, of the President's assassination. They stood as witnesses as Chief Justice Chase of the Supreme Court swore in Johnson as President on the morning of April 15.

In 1871, President U.S. Grant offered him a seat on the Supreme court. Senator Stewart declined the opportunity, preferring instead to remain in his representation of Nevada.

Senator Stewart was more than the father of the mining law. He considered his authorship of Fifteenth Amendment of the U.S. Constitution to be his most important work. Becoming law on May 30, 1870, it reads:

"The right of citizens of the United States to vote and hold office shall not be denied or abridged by the United States or any State on account of race, color, or previous condition of servitude. And Congress shall have power to enforce the provisions of this article by appropriate legislation."

THE 1872 MINING LAW

Although much criticism has been levied of late toward the mining law by those ignorant of its value, it truly brought order out of chaos. For example, as a result of ambiguities and flaws in mining district bylaws, mining claims were very numerous. The Comstock Lode was covered by nearly 10,000 locations (claims) made before 1871. If the 1872 mining law had been in place before the Comstock's discovery, that section of the lode from Gold Hill through Virginia City could have been covered by ten claims. The effect this would have had on litigation is obvious.

PAYOUT!



The history of the Comstock Lode is permeated with litigation. Decisions were being made in courts resulting in literally millions of dollars to the winners. The pressure on those involved was enormous. Bribery was not uncommon.

One of the most popular anecdotes arising out of that time concerned a particular judge. A payment of \$15,000 was to be made to enlist his favor. Obviously some discretion was necessary.

One dark night, at a very late hour, a visitor appeared at the judge's home. His wife answered the door—in her nightgown. She held it out as a linen shelf. The bag containing the money in gold was dropped onto her outstretched nightgown.

Although small in volume, the bag weighed over 50 pounds. When the weight took hold of her nightie, it was ripped from her body. She was left standing stark-naked in the doorway. We are not told who was the most surprised.

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ALBERT E. CRANE.

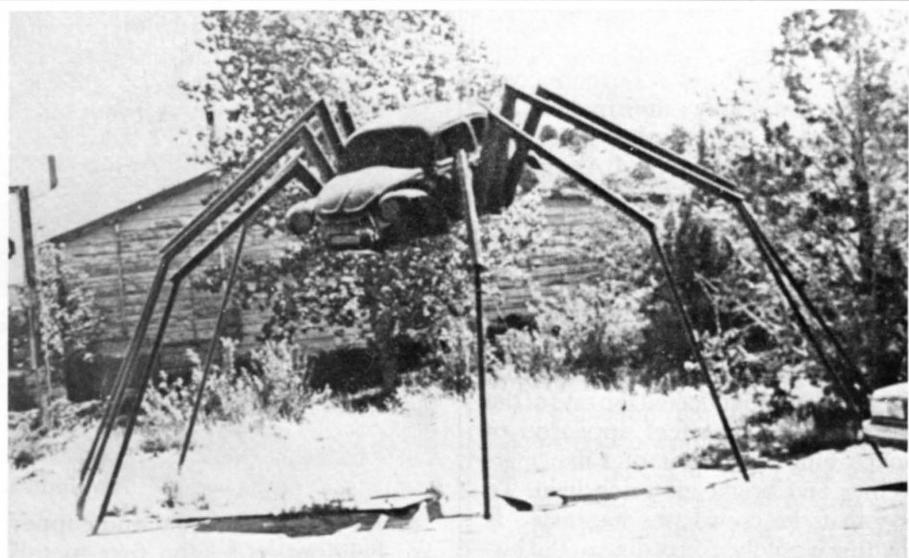
CRITTERS

Arachnida ferrous autovw: An Iron Maiden

East of Carson City, Nevada, along U.S. Highway 50 is found *Arachnida ferrous autovw*, a rare creature which is not listed on any federal rare or endangered species list. It is the remaining survivor of the only pair known to all time. The other, late of Steamboat Springs, is no longer with us.

Although facing slow decay in an oxidizing atmosphere, it is not the least wary of humans and in fact exists in close proximity to many. Not at all shy, the last of the breed seems to prefer a habitat alongside the highway. More specifically, adjacent to *Tom's Auto Body and Paint Shop* where it strikes a rigid pose above the remains of the last two-ton meal. Known locally as the "Black Widow," this dainty female (you can tell by the red hourglass on her belly, er... under-carriage), stands 18 feet high and has eight legs that span 30 feet toe-to-toe. Each gracefully angled, albeit thin, four-inch diameter leg weighs 450 pounds. Weighing a svelte 4000 pounds, this *femme fatale*, in part, immigrated from Germany in the 1960's.

No Brunhilde she, and then known as the species *Volkswagenus germanicus*, or VW for short, this poor creature wound up a castoff in a Nevada farm field—battered, broken and unwanted. A man who had also immigrated to this land from Thousand Oaks, California, David Frambrough by name, took



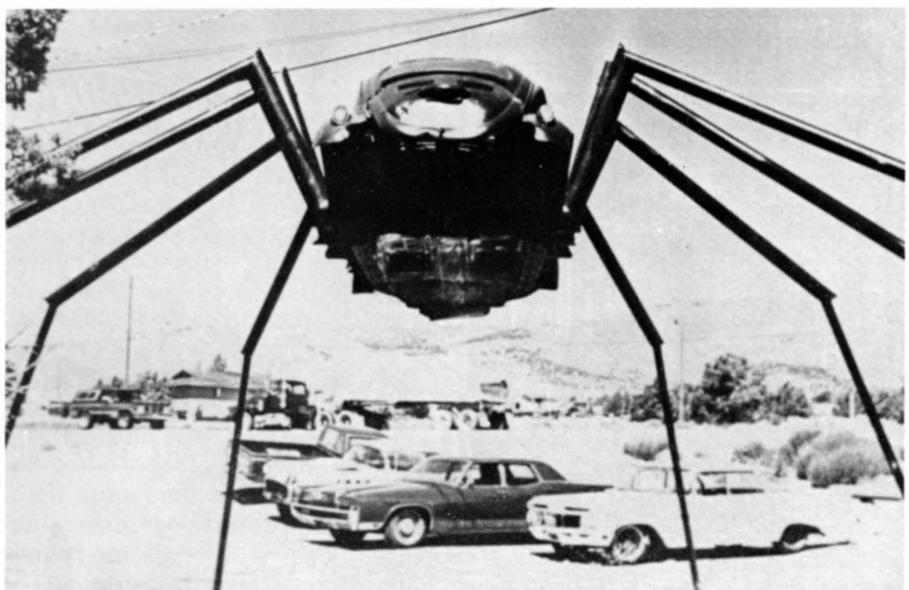
I don't like hoods!

pity upon this poor damsel in distress and one day rescued her from extinction. What drew him to VW was not her dismal shape but her possibilities—she looked like a bug. Being of an artistic bent, Dave liked to draw pictures—of insects.

He saw in VW potential unrecognized by others. The metamorphosis of VW took some six months to accomplish with the assistance of his friend Tom. With some salvaged iron irrigation pipe, VW got a leg up—eight actually, and viewed the world from a height unknown to her

since she first was taken off the boat in New York City. After the excision of some unnecessary components and acetylene surgery, she received a new coat of shiny black paint with just a touch of red and took up residence next to Tom's place.

If you some day travel to the Comstock mines from Carson City, watch for her. She can still be seen, like the proverbial bug's ear, south of the highway. If you have an iron constitution and want to see her up close, approach her with caution she may need another meal.



Next...

ANTIQUITY

Silver in History

It was August 6, 44 A.D., the second day of the games being held at Caesarea in honor of the Roman emperor Claudius. Herod Agrippa I, grandson of Herod the Great, was holding these games in Caesar's honor. The games started early to minimize the summer heat. At sunrise the 54 year old Herod entered the theater wearing a robe woven entirely of silver. The texture of the silver cloth was such that it collected and reflected the rays of the rising sun. The effect appeared to make him the center of some marvelous and bright glittering light. To say that the crowd was impressed is putting it mildly. According to the historian Josephus, they were terrified. Whispers circulated that he was a god. While basking in the glory that his silver robe was creating, he spotted an ill-omen in the form of an owl sitting on a rope nearby. He became gloomy and was suddenly struck with an intense pain in his stomach. Five days later this new 'god' was dead.



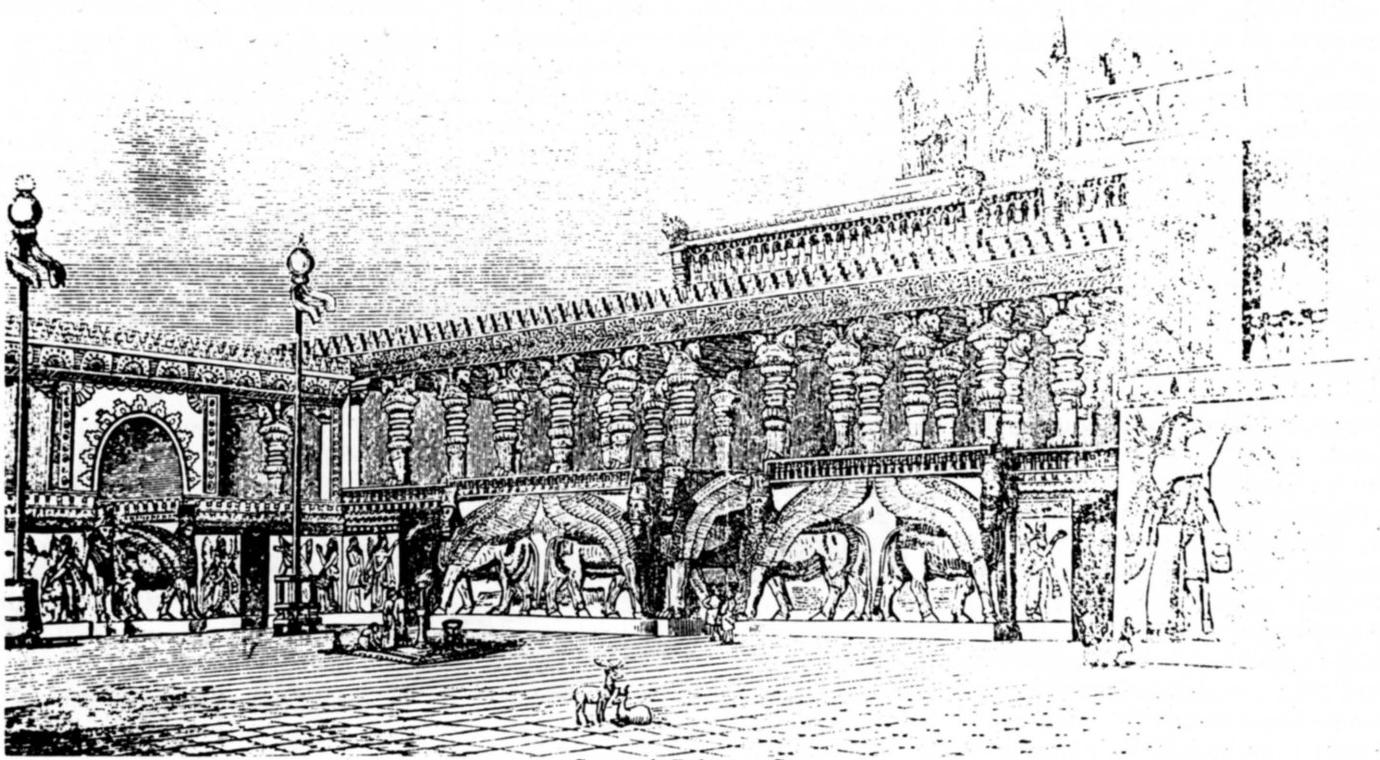
Amphitheater at Caesarea

Silver along with gold and copper are believed to be the first metals discovered by man. At some point in the distant past the presence of silver in lead ores was recognized, and the method of its release was discovered.

Worked silver has been found in ancient **Sumerian** cities dated around 2500 B.C. In Ur, silver was used for musical instruments and figurines. Silver dishes have been

found at Pompeii (79 A.D.) and the famous silver chalice of Antioch, was also ascribed to the first century A.D.

In the time of **Sargon** the Great (c.2370 B.C.), the Taurus Range (in Turkey) was known as the Silver Mountain. Sargon needed the mines and the silver produced there. The only thing standing between Sargon and his goal was a coalition of 32 kings who wanted to keep their sil-



Sargon's Palace at Susa

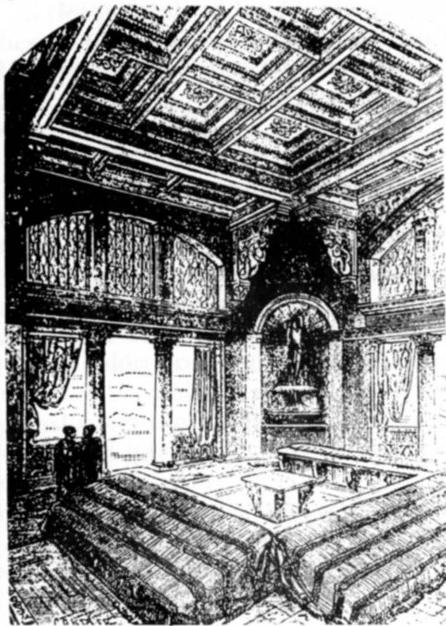
ver mines. Sargon mounted an expedition to expropriate the mines. He defeated the kings and took possession of the silver mines along with a source of black diorite used extensively in monuments and art. In expanding the Akkadian frontiers, Sargon laid the foundations for the Babylonian empire.

Although the institution of coinage for monetary purposes is attributed to the Lydians in the 7th century B.C., as early as the 3rd millennium B.C. silver was the basic standard of both weight and value. It was used in the form of ingots and other shapes; the duck was a popular shape with the Babylonians. This bulk form was stamped with the minimum silver content.

Two popular units of weight in the ancient world were the **mina**, which weighed about 18 ounces, and the **talent** which weighed 60 minas. A smaller unit was the **shekel**, which weighed in at about 0.3 ounces.

Around 1400 B.C. silver was worth $\frac{1}{4}$ to $\frac{1}{3}$ the value of gold. During the time of Solomon (c.950 B.C.) silver was worth 10% that of gold. At that time the annual royal tax amounted to about four pounds (or four minas) of silver per family.

In the Bible, silver is mentioned about 300 times. It was used as a standard of wealth and also for money. In fact it is believed to have been a silver **denarius** that was placed in Christ's hand. The Hittites



Banquet Hall

seemed to control the silver trade for a considerable period of time. The fall from importance of Athens as a state seems to have coincided with the exhaustion of the silver mines of Laurion in Attica.

Herodotus (484-425 B.C.), tells us that the Persian kings drank water only from the river Choaspes that



Domitian

flowed past their capital Susa. When away from Susa, they drank only boiled water carried in silver canteens on four-wheeled wagons drawn by mules.

The emperor Domitian (81-96 A.D.) buried three Vestal Virgins alive, the traditional punishment for immoral behavior, and walled up another in an underground room while her lovers were beaten to death with iron rods just outside. He seduced his niece and forced her to have an abortion, which killed her.

On a dark night in 89 A.D., Domitian held a banquet for some distinguished senators and knights of Rome. He forced them to leave their attendants at home and came only with their litter-bearers who stayed outside.

The honored guests entered a room that had a black floor, ceiling

and walls. The couches (they ate in a reclining position) were also upholstered in black. The only illumination was that provided by small flickering oil lamps used in tombs. The lamps were fastened to black tombstones which were placed next to each couch. Each tombstone had the name of a guest on it. These were the place-markers.

Naked boys painted black then danced around the room. After the dance, each boy took up a position at the feet of a guest and placed at his feet expensive items normally offered to the spirits of the dead. These items were all black and were served on black dishes.

All expected that the next item on the program would be the slitting of their throats. The meal was served in absolute silence with only the emperor speaking. Domitian spoke on topics related only to death and carnage.

After what seemed like an eternity the banquet ended and the guests were led to their litters and carriages where slaves unknown to them waited.

After arriving at their homes and beginning to breathe easier, they received notice that a messenger from the emperor had arrived. When they mustered the courage to meet the messenger, they found it to be the boys who had served them but now the boys were dressed and clean. Each guest was given the gifts presented to the dead spirits at the banquet. Each guest was also given the tombstone inscribed with his name. These tombstones were made of silver. Such was life in ancient Rome.

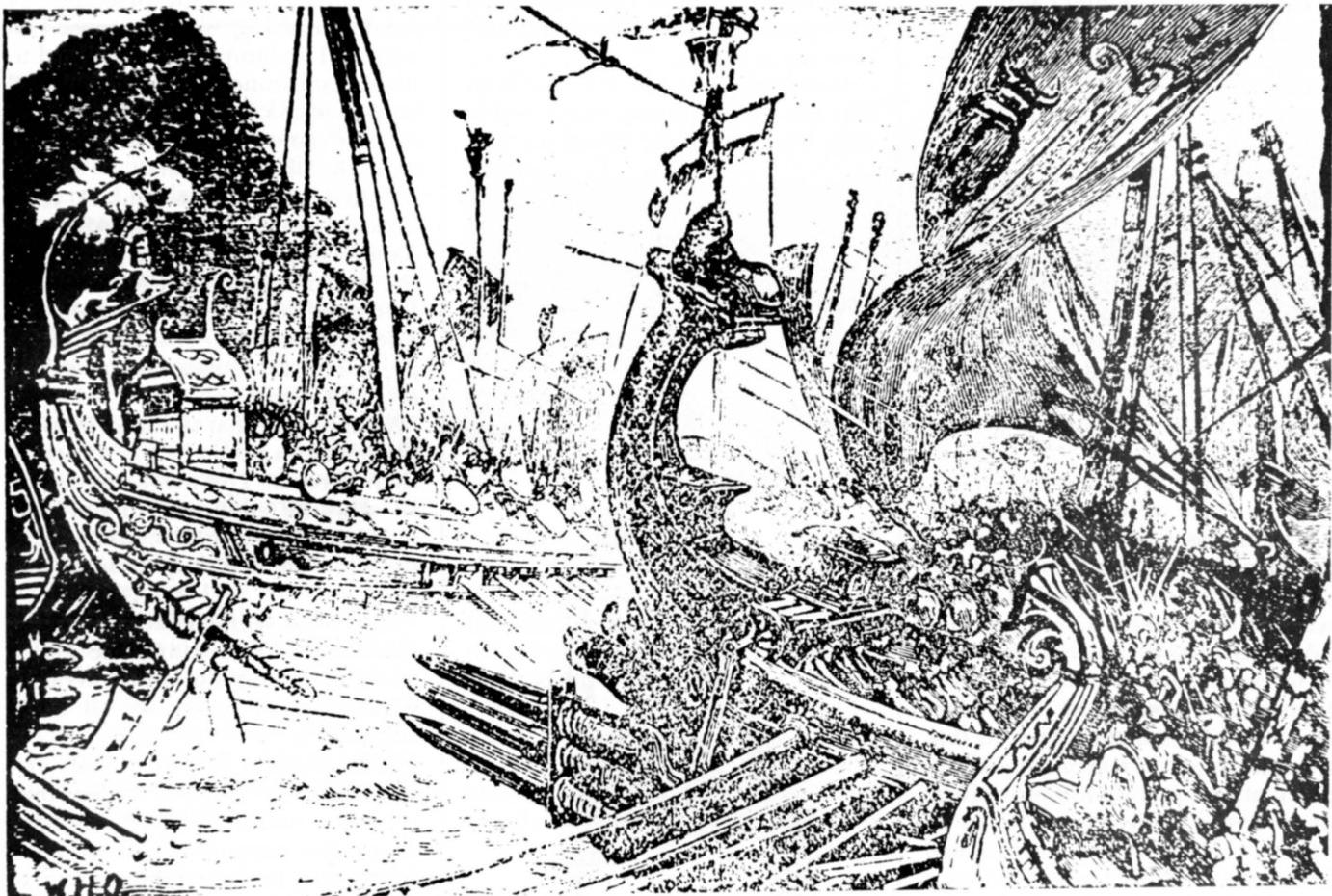


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SIDETRACK

The Battle of Salamis



By Marion F. Ely II

A discovery deep within the dark interior of the earth's crust led to a series of events which changed the history of the world. The discovery led to the thwarting of a Persian invasion of Greece in the fifth century B.C. and to the ascendancy of Greek power. The discovery was made by a man whose name is lost in time. He was a miner working deep within the mines of **Laurium**. His discovery? High-grade veins of silver ore. The year? 484-483 B.C.

The Laurian Mines paid revenue that was simply divided among the 30-40,000 men of Attica. The discovery of high-grade veins of silver led to a flood of silver being introduced into the Athenian economy. Each man was to receive about 10 **drachmas** (1.38 ounces of silver). The amounts were so significant that, for the first time, questions arose about how it should be spent. This was a question the Greeks would not quickly resolve.

The Greeks were a factious people that succeeded in spite of themselves. Their history is marked by feuds and armed conflicts that inhibited their cohesion as a nation. At this point in time Athens was

considering a war with the Aeginae who lived on an island to the northwest.

A 42-year old Athenian by the name of Themistocles believed the money should not be distributed to the populace. He said they should use the money instead to build 200 triremes. These could then be used in a war with the Aeginae.

Xerxes had an army over 360,000 and a fleet of 1,200 ships

The triremes were built. Three years later (480 B.C.) while the people were debating who would be the commander of this new fleet, the Persians, under king Xerxes, invaded Greece. He had a land army of over 360,000 strong and a naval fleet of around 1200 ships.

The Thessalonians and a number of other Greek states went over to Xerxes' side as the Persians occupied more and more of Greece. Xerxes' envoys came to Athens and asked for earth and water as tokens of surrender.

The people were offended that the Greek language had been used to transmit the words of the barbarian Xerxes. As a result they demanded that the interpreter be executed. He was. A family was also executed because they tried to spend Persian gold coins.

In the face of an imminent threat, Themistocles wanted the citizens themselves to man the triremes. They disagreed with him. In disgust he joined the Spartans who were taking the lead in meeting the Persian threat.

The Athenians supplied the greatest number of ships in the Grecian fleet, but they refused to be commanded by the Spartans. Themistocles finally convinced them that if they fought well all Greeks would honor them with leadership later.

In the face of the Persian army's advance, the evacuation of Athens was started. The Athenian men were leaving for the war so their wives, children and slaves were moved to Troezen for the duration. The residual population of Athens was composed of old men and animals. The citizens gave each Athenian family two *obols* (0.716 grams of silver), per day for expenses. The children were permitted to pick fruit, and their teachers were paid. Not to be outdone, the Eubonians gave 30 *talents* of silver (27,000 ounces) to the war effort.

At this point the Athenians became hesitant to man the triremes without being paid. Each man was therefore advanced eight drachmae (1.1 ounces of silver; about 24 days' pay).

The fleet left with the Spartan Eurybiades in command. Their destination, Salamis. There they hoped to stop the advance of Xerxes to the Peloponnese and thus prevent the conquest of Greece. The Greek fleet arrived at sundown.

That night at the Greek strategy meeting Themistocles sensed his aggressive position would fail; some wanted to go to a different position, others were ready to give up. He quietly took his slave Sicinnus aside.

Sicinnus was a Persian prisoner of war who had been a tutor to Themistocles' children and had grown to like the family. More im-



portant at this time was the fact that Themistocles trusted him. His judgment of the Persian would now be tested as he sent him to Xerxes with a secret message.

The Greeks continued their arguing until some agreement was reached and the need to propitiate the gods was mentioned.

During earlier engagements the Greeks had captured three of Xerxes' nephews by his sister Sandauce. When the prophet Euphranrides saw them, he heard a sneeze on the right (a good omen) and said he saw a flame shoot up from them. The prophet instructed Themistocles to sacrifice them to Dionysus, the eater of flesh. When Themistocles resisted, the men around him dragged them to the altar where they were sacrificed.

Sicinnus succeeded in reaching Xerxes under cover of darkness. He told the king that Themistocles had come over to Xerxes' side and had a message for him. The message was that the Greek fleet was planning to escape in order to link up with its army. The only way to prevent this was to block the channel and destroy the fleet. Xerxes believed Sicinnus and at midnight ordered his Egyptian squadron to circle the island and come up behind the Greeks. By morning the Egyptians were in position.

When the early light of day illuminated the scene on September 22, the Greeks realized that they were trapped. Virtually all of their fleet was contained within the channel. The Athenian triremes numbered 180 and were supplemented

by 196 ships from other Greek city-states. Xerxes' losses in the war had reduced his fleet substantially, but he still had over 600 ships at Salamis.

Xerxes felt that his presence was necessary to buoy the spirits of his men. During the war he had lost both men and ships, and this was beginning to wear on them. Xerxes selected a spot above the hills known as 'The Horns'. It overlooked the channel that separated the island of Salamis from the mainland. Xerxes then had a gold throne set there so he could watch the battle. His secretaries were at the ready to record the events of the day.

In the middle of the channel was the island of Psyttaleia. Xerxes landed a contingent of troops there to kill any Greeks that reached it. A triple line of Persian ships faced the Greeks. Among the Persian commanders on these ships was Xerxes' brother Ariabignes.

*1,000 ships and over
150,000 men fought for
their lives*

Both the Persians and Greeks had been up most of the night in preparation for the coming battle. Now in the light of day Themistocles addressed the men, exhorting them to defeat the Persians. He then gave the command to man the ships, and they set out from shore. They seemed to be taking some time in taking up their positions, but Themistocles was waiting for the

wind to blow in from the Aegean Sea through the strait. Xerxes' admiral, Ariamenes, was opposite Themistocles.

The ships began jockeying for position, and the Persians moved forward. The Greek ships blocked the advance but were backing up at such a rate they were in danger of running aground. A Greek trireme rammed the Persian admiral's ship head-on. Their bronze "beaks" locked the vessels together, and the Greek ships rushed in to assist. The battle was engaged, and the confusion of battle spread from the two locked ships through the channel.

The Greek triremes were by far the most maneuverable and speedy ships in the conflict. The Persian ships, although larger, were slower and more sluggish in changing position but had decks that towered over the triremes.

The aqueous arena for this battle measured only about one mile in width and perhaps two miles in length. Within this area nearly 1000 ships and something over 150,000 men (and at least one woman) fought for their very lives. In the balance was the expansion of the Persian empire into southeastern Europe and the fate of the Greeks as a people.

One of Xerxes' captains was the queen of Caria, a woman named Artemisia. During the battle she was spotted by some Greeks who knew of her and recognized her colors and began pursuit. In trying to evade her pursuer, she saw that she was headed into another group of Greek triremes which blocked her escape. One of her friends, Damasithymus, the king of Calynda, was on his ship nearby. She advanced at full-speed toward him. She rammed his ship, and it sunk with a loss of all hands. The Greek pursuing her figured she was deserting the Persians and broke off pursuit. The Athenians were so outraged that a woman would appear in arms to fight them that they offered a reward of 10,000 drachmas (1382 ounces of silver). She was not captured however.

As the ships closed in combat, the four Greek archers on each trireme showered the Persian ships with ar-

rows. In return the Greeks received javelins from the Persians. When a ramming or collision slowed warring ships, the 14 soldiers on each trireme fought to kill the opposing crew or to defend their own.

The wind began blowing in from the Mediterranean, creating a swell that rolled through the channel. The large Persian ships were turned by the wave action broadside to the Greeks. The triremes struck these best of target positions ferociously.

Some of the Persian ships in the first of three lines of ships turned to flee the battle and became tangled among their sister ships. The Greek triremes took full advantage of their

continuation of battle the next day. The Persians fled and the battle never occurred.

That evening Themistocles again used a ploy that had worked well. From the captured prisoners, he discovered a royal eunuch whom he secretly dispatched to Xerxes. The message this time was that the Greeks were now going to send a fleet to cut off his retreat to Persia. This would be accomplished by the destruction of the bridge of ships Xerxes had constructed across the Hellespont, which separated the middle east from Europe. A feint with a tiny Greek fleet gave the threat credence. It worked.



abilities and darted in and out among the Persians like so many mosquitos harrying their prey. The battle had become a rout of the Persians.

Bodies and wreckage clogged the waters and beaches

The carnage and destruction that day was tremendous. Bodies and wreckage clogged the waters and beaches. Few of the Persians could swim, so many lost their lives when their ships were sunk. The Greeks lost 40 ships and the Persians over 200. The human casualties were in the thousands.

The Greeks towed into shore as many of the damaged vessels as they could to prepare them for the con-

The psychological factors attending the battle along with Themistocles' ploys sent an unsettled Xerxes back to Persia. He left the campaign in charge of his general Mardonius.

Although the battle of Salamis did not immediately end the war, it was a decisive turning point. The Persians final defeat came within a year.

What gave the Greeks the edge was their triremes. Without their triremes the outcome of the battle could easily have been quite different. What gave the Greeks nearly half of their triremes was silver—silver that was discovered in high-grade veins in the mines of Laurian only three years before. This discovery triggered changes which led the way to an event that changed history. The effects of the Greeks' victory at Salamis paved the way for a man named Alexander the Great. The rest, as they say, is history.

Triremes

The design of Greek warships evolved over a period of nearly 400 years. The ultimate, achieved in the late 4th century B.C., was called the *trireme*, i.e. triple-oared. The trireme was the backbone of the Greek navy. It carried a crew of 170 men plus officers and supported an aggressive military force of 18: four archers and 14 soldiers.

The trireme was designed by a Corinthian named Aminocles in the ninth century B.C. Built in Athens, triremes were constructed of pine and fir for strength and lightness. There apparently was inadequate sealer available to prevent them from waterlogging. This situation required that they be beached nearly every day.

With a displacement of about 40 tons, the trireme was a double-convex outlined vessel approximately 120 feet in length and with a beam of about 12 feet. The deck was approximately 16 feet in width and was perched about eight feet above the water. The oar length was over 13 feet.

The deadly trireme was the fastest ship of antiquity. It was designed for speed, rowing and ramming efficiencies. With a top speed of about 11.5 knots (13.2 mph) and a cruising speed of 8-9 knots (9-10 mph) nothing could match it. With a bronze 'beak' for a ram, it dealt a fearful blow to enemy ships. Conversely, when a trireme was rammed, due to the light woods used, it generally did not sink - it just settled in the water and became unusable. Although constantly in need of repair, a trireme could last 20 years.

The trireme's motive force was muscle-power. A crew of 170 oarsmen generated approximately 40 horsepower. They were placed on three levels, one above and slightly ahead of another in a face to backside arrangement.

The oarsmen on the bottom bank, 27 to each side of the ship, were called *thalamioi*, "hold-rowers", due to their location and position which was about two feet above the water. The men on the next level, also numbering 27 on each side, were

called *zygoi*, "thwart-rowers". The upper level of oarsmen numbered 31 on each side. They were called *thraniitai*, "stool-rowers" since they were seated. This was the highest paid labor due to the difficulty in rowing so high above the water. The average pay of a sailor was about two **obols** per day or about 1.4 grams (0.045 oz.) of silver. (At a price of \$5.00 per ounce, this would amount to 22.5 cents per day - an indicator of how purchasing power has changed over the last 2400+ years!)

The crew was directed by a captain or *keleustes*, "the giver of orders" and was assisted by a small number of junior officers. His job was critical in times of battle. He had to judge his enemy's speed and position as well as his own. If he misjudged his course, the target could be hit in the wrong place or, in the worse case, he would miss, and his ship become the victim. In war, the goal was not only the destruction of the ship but the slaughter of the trained crew. Such was the life of the ancient mariner.

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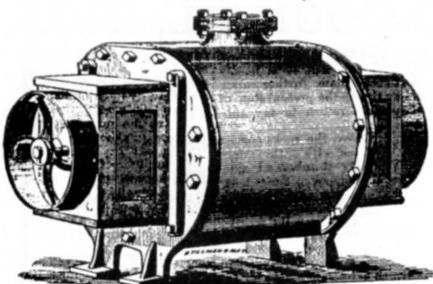
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OLD TOOLS OF THE TRADE

The Root Blower

On November 1, 1864, a patent was issued to P.H. and F.M. Root of Connersville, Indiana. The patent was for what they called the Force Blast Rotary Blower. The first unit was installed in Covington, Kentucky. Its popular and widespread use later led to it becoming known simply as the Root blower.

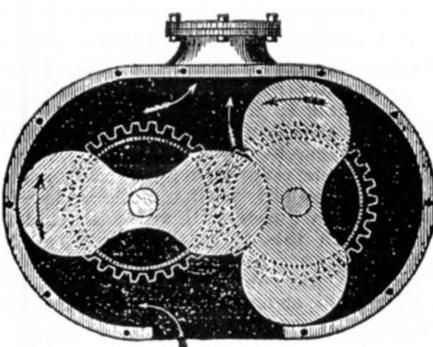
Mid-nineteenth century technol-



The Root Blower

ogy replaced bellows, which had been used for centuries, with high-speed fans, which were limited in output, and reciprocating engines utilizing pistons and cylinders. The Root's approach to the problem was innovative.

In a break with existing practice, the Roots rejected reciprocating motion and the complications it entailed, and chose instead rotary motion. Their solution resulted in a sophisticated design requiring only a few moving parts.



Roller Valves

Two machined roller-valves with a figure eight cross-section rotated within a machined cast-iron casing. Their movement was synchronized

by gears mounted on the drive-shafts. Motive power was applied through a pulley mounted on either end of a drive-shaft. In the pre-electric and gasoline engine age, power could be provided by animal, water-wheel or steam engine. Air entered the blower from below and was exhausted through the top of the assembly.

Machined with the precision of a steam engine, the Root's blower provided a wide range of supply. Rotating at 15-20 rpm supplied enough air to operate a blacksmith's forge. The blower had the capacity to supply up to 20 such forges by simply increasing the speed. In iron foundry or smelting use, speeds of 250-300 rpm were common. In such use power requirements were one-half that required by a rotating fan which operated at speeds in the range of 1500-1800 rpm.

The Root's efforts were rewarded by wide acceptance and a 'First Premium' prize at the Paris Exposition. Although their original goal was to provide a simple blower of controlled output for use in blacksmith's forges and foundries, it soon found a use which perhaps they had not envisioned.

As one might expect, the Root blower was used in smelting and refining operations at many mines. It was used at the Almaden mercury mines in California and at Gridley's Foundry, Gold Hill, Nevada. Although these were uses for which it was designed, far more important was its use underground.

On the Comstock Lode in Nevada, as men recovered ore from ever increasing depths, heat became an unrelenting enemy. The rocks contained hidden springs of waters so hot that eggs had actually been cooked in them. Water temperatures of 170° F. were measured and, although the normal air temperature was over 100° F., temperatures up to 130-140° F. were not uncommon. The light produced by flickering candles was so enfeebled by a lack of oxygen that it required four

in the mine to produce the light of one at the surface. In addition, the light produced was an eerie pale-blue color. This lack of oxygen also affected the men. The heat and humidity reduced their efforts about 75%.

The heat and humidity coupled with the hard physical labor caused intense perspiration. In 1866 the Belcher mine had attained a depth of 900 feet. The men's shoes were literally filled to overflowing with the sweat that trickled down their nearly naked bodies.

In efforts to ameliorate such harsh working conditions, the miners were provided a three gallons supply of water per day for drinking. Perhaps even more appreciated was the 95 pounds of ice per man that was provided each day. It was calculated that the heat annually generated in the mines was equivalent to that produced from 55,472 tons of anthracite coal!

As depths nearing 1000 feet were reached, progress was so slow that the future of the mines was in some doubt. Iron tools had to be insulated so that they could be held. Worst of all, men were literally dropping dead in their tracks.

Natural ventilation of the mines through common connections and out the shafts was considerable. It was not effective however, in the dead-ends of the drifts and stopes where the men worked.

By 1868 definitive action was required. Enter the Root blower. Blowers were placed in the depths of the mine to direct air to where the men were. Iron pipes ranging in diameter of 8-20 inches directed the air to where it was needed. A supply of 700 cubic feet per minute (cfm) met the needs of from two to six men. Within only a few days of operation, temperatures dropped 10-20° F. Efficiencies began to rise and work progressed.

By 1877 blowers provided 30,000 cfm per day to the mines' interiors. An additional 10,000 cfm were added by compressors to the

300,000 cfm acting naturally. Every minute of every day 11.5 tons of air moved through the mines. Although conditions were never ideal, depths of over 2000 feet were reached before the mines were ultimately closed.

If someday while visiting an old mine or mill you find an iron relic that looks like some strange form of heavy-duty washing machine with odd-shaped rollers, look closely. You may have found a Root's blower — one of the machines that made deep mining on the Comstock possible.

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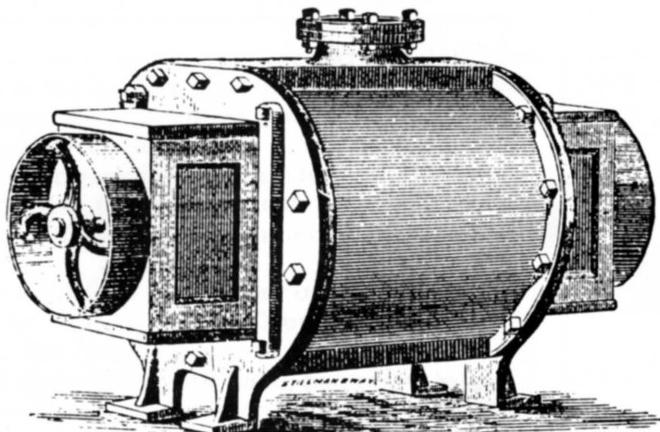
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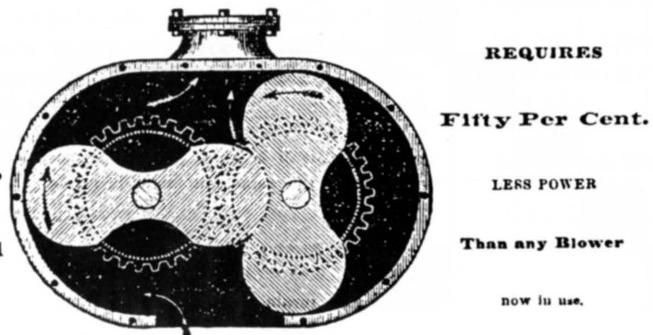
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—Dealer in—

Giant Powder,

Fuse and Caps.

HAVING JUST RECEIVED a
Carload of the above Powder I am
Prepared to Contract with
—Mining—

Companies,
AT

Reduced Prices by the
TON.

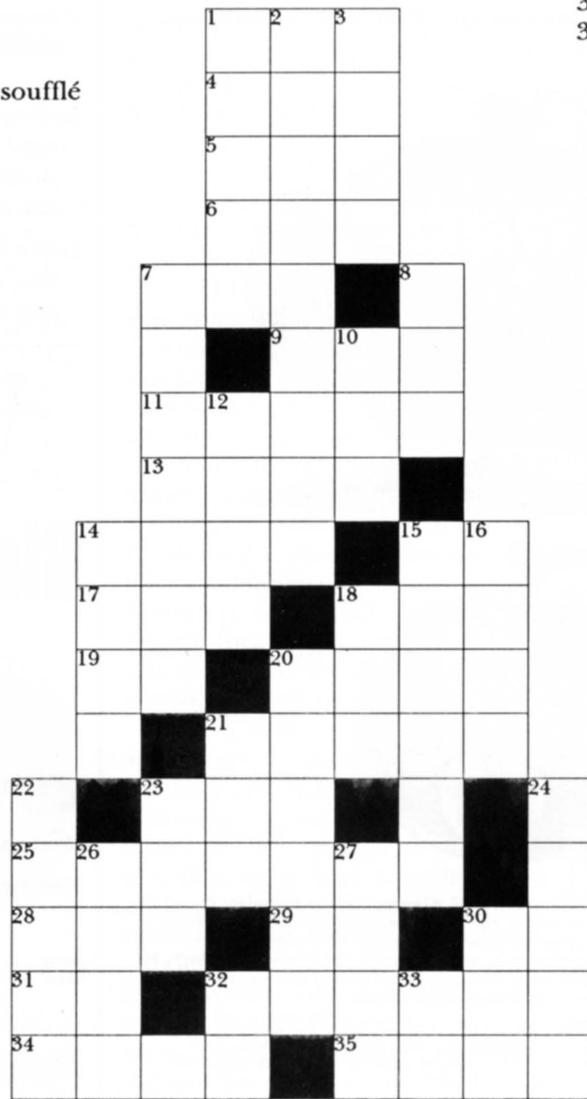
CROSSWORD

ACROSS

1. Bashful
4. Orange Pekoe
5. Auditory organ
6. Find the sum
7. Tiny prankish fairy
8. Decay
11. Void of meaning
13. Past,present, future
14. Crutch
15. One of original 13 states (abr.)
17. Monkey
18. Taxi
19. Hush (slang)
20. Zoo home
21. Flat bottomed boat
23. Buddy
25. Chemical used to extract gold
28. Type of Bran
29. The Golden State (abr.)
30. Not off
31. Medical profession
32. Perfumed ointment
34. Main ingredient in a soufflé
35. Belonging to Eve

DOWN

1. Pilfer
2. Mining News
3. Lawn
7. Gravestone tribute
8. Consumed
10. Number of schools in Calico
12. What a stitch in time saves
14. Currency
15. Silver mine at Calico
16. Not a wasp but - - -
18. Auto
20. Silver mining camp
21. Prohibit
22. Points in a game
23. A gentle tap
24. Odessa,Oriental,Bismarck
26. Not yin but - -
27. Wife of a knight - -
30. A lyric poem
32. Postscript
33. Avenue (abr.)



Answers: Page 42

TESTIMONY

HR 3866: The Anti-Mineral Exploration and Development Act of 1990?

Representative Nick Rahall of West Virginia has introduced HR 3866 entitled the Mineral Exploration and Development Act of 1990. It would repeal existing mining law developed over nearly 120 years which has given a measure of stability to a high-risk and already highly regulated industry. In opposition to this proposal Mr. Sanregret, A.B., M.B.A., J.D., an attorney practicing in Santa Ana, California, represented the Western Mining Council, Inc. before the United States House of Representatives Subcommittee on Mining and Natural Resources of the Committee on Interior and Insular Affairs. His abridged remarks before the Committee on September 6, 1990 in Washington D.C. give insight into the adverse impacts created by this attempt to change a basic law that has served the citizens of this country well since its enactment.

by Robert A. Sanregret

Tantamount to Nationalization

Our opposition is based upon the fact that HR 3866 would repeal the current United States Mining Law's efficiently-operating incentive system of mineral exploration and development, and would replace it with a cumbersome acreage-based "lease/fee system" consisting of restrictive fees and regulations tantamount to *nationalization* of United States mineral exploration and development.

In fact, to more fully develop our own limited mineral potential, the Western Mining Council strongly recommends that the incentive-based United States Mining Law not be destroyed by HR 3866, but, rather, that the Mining Law be *expanded* to specifically include the following: (a) *Federal acquired lands* in all states and territories; and (b) *deep seabed lands* to the 200-mile limit.

This valuable United States resource of utilizing the self-initiation and incentive of private citizens to explore for minerals and to develop mines under the United States Mining Law *at no cost to the public* should not be destroyed, as it would be under HR 3866.

Not Just One 118-Year-Old Statute

Most major mines and most major mineral deposits in the United States have been discovered by individual mineral prospectors under United States Mining Law.

The United States Mining Law consists of hundreds of statutes, regulations and court decisions dating from 1807 to the present time. The 1872 General Mining Act is one of about 65 separate mining statutes, and is an important part of United States Mining Law; but it is erroneous to refer to the composite United States Mining Law as "one outdated 118-year-old statute", because

there are hundreds of interrelated "Mining Laws" which have been continuously amended and updated, resulting today in the present *clearly-defined* and *predictable* set of ground-rules for efficient mineral exploration and development on public land.

The United States Mining Law operates to efficiently locate and identify minerals on public lands, and has been aptly referred to as "the world's premiere remaining example of an incentive-based free enterprise system at work". We need mineral exploration and development under the Mining Law today more than ever before. For example the Soviets have lost the "Cold War" largely because we were *more productive*, particularly including our mineral exploration and development under the Mining Law. However, the Soviet Union has about three times the mineral potential of the United States. The Soviets are well on their way to finally figuring out our free enterprise system and our Mining Law; and when they do, they will be in a position to "bury us" economically, unless we keep our own mineral exploration and development alive and well under the Mining Law. Today we, and most of the world, are absolutely subservient to the Soviets and South Africa for virtually all of our chromium, rhodium, platinum and other essential minerals. It is a distinct possibility, if not a probability, that the United States and many other countries will be subject to political and financial extortion by unfriendly foreign mineral cartels, which would be much more serious and damaging to our productivity and to our national security than the current envisioned "oil crisis".

Chairman Rahall's Questions

In July, 1990 Subcommittee Chairman Rahall asked the following two specific questions, to which I shall now respond.

Chairman Rahall's Question #1:

"Can the United States expect to have a viable mining industry in the year 2000 and beyond, under HR 3866?"

Answer:

The answer is "No." HR 3866 would *devastate* the present incentive-based mineral exploration and development industry in the United States.

Despite the title of HR 3866, it would stop and destroy most United States mineral exploration and development by its heavy-handed acreage-based "lease/fee system", tantamount to *nationalization*. Under HR 3866 a substantial amount of our mineral exploration and

When existing mines are exhausted...

development would *stop* because most individuals and exploration companies would be put out of business by the restrictive additional fees and regulations under HR 3866. Today's mineral exploration and development by thousands of individuals and firms would be difficult or impossible under the acreage "lease/fee" system proposed under HR 3866. If United States mineral prospectors are prevented from discovering and developing new mines under HR 3866, the direct result would be that when the existing mines are exhausted, only a few of the financially strongest mining companies would be able to develop new locations under HR 3866's new layers of fees and restrictions, and under the array of existing and new "anti-mining" laws and regulations. The result would be the *exportation* of mineral exploration and development, the exportation (loss) of thousands of jobs in the United States, an increased trade deficit resulting from the purchase of foreign minerals (while ours lie "fallow" and undeveloped), and subservience to foreign mineral sources. The "oil crunches" experienced in the United States during the last 20 years, and of today (even with a worldwide oil glut), dramatically demonstrate the obvious serious detriment to the United States being dependent upon and subservient to unreliable foreign sources for oil, *or for minerals*.

Disguised as Environmental Laws

"Anti-mining" laws are frequently disguised as a revenue-raising", "wildlife" or "environmental" laws, many of which should not have been enacted in the first place without full Environmental Impact Reports, or at least with a full analysis and consideration by the Subcommittee of the *economic* effects.

Even now, the continuing detrimental "chilling" effect of many of our *existing* laws and regulations should be fully examined. Of specific critical concern are the many thousands of jobs and billions of dollars lost or endangered by erroneous and premature accusations and regulations under certain "environmental laws", and, under the particularly egregious Endangered Species Act. These environmental laws and the Endangered Species Act have already created new cumbersome layers of bureaucracy, spurred on by the private and well-funded environmental activist groups pushing their hidden agenda of "*No Development, No Mining and No Oil*".

Under the Guise of "Revenue Raising"

HR 3866 is proposed as a "revenue raising" bill, *but* will cost much more than any revenue raised. The real frightening agenda of many devoted proponents of anti-mining legislation such as HR 3866 under the guise of "revenue raising" or environmental laws, is to rid the United States of mining, all mineral exploration and development, and of all *development*.

The United States mineral exploration and development is subject to the strictest environmental regulations in the world. United States mining today does not hurt or destroy the environment. Miners and prospectors are very much "pro-environment", and do much more for the preservation of wildlife and the environment than do most of the vocal environmental activists. Miners do not hurt or kill animals; and in fact, mining activity has substantially increased the numbers and well-being of much wildlife, specifically including the Desert Tortoise and Bighorn Sheep.

The mineral exploration and development industry today is operating efficiently and in compliance with all of the currently strict environmental controls; *but*, HR 3866 could well be the *coup d'état* to end our efficient incentive-based system of mineral exploration and development.

A Secure and Stable Supply of Hardrock Minerals

Chairman Rahall's Question #2:

"Can the United States expect to have a secure and stable domestic supply of hardrock minerals under the present Mining Law?"

Answer:

The answer is "yes."

The incentive system of our present Mining Law encourages citizens to conduct mineral exploration on the United States public lands. This system operates to effectively locate and identify mineral deposits, and permits and encourages the locator to either develop a mine or to "inventory" the minerals for future extraction. In 1955 one of the many amendments to the Mining Law initiated the concept of "Multiple Use" of public lands; and today a mineral prospector or miner does not have the exclusive possession and use of his mining claim until the claim-holder has patented the land by proving the presence of a substantial mineral discovery and a development plan that is feasible and reasonable.

Mineral Patents

Mineral patents have been the subject of substantial recent discussion, and patenting seems to be widely misunderstood. Mineral patenting is the incentive and protection provided to good faith mining claim locators. This protection is the exclusive mineral rights given to the citizen of the United States who discovers a mineral deposit, and the citizen's right to acquire title by a patent. There is no up-front subsidy by the federal government, no "subsidy payment" for not prospecting, and there is no payment for not producing. Obviously only a small percentage of mineral exploration prospects result in profitable mines. During the mineral prospector's exploration and development activities, the prospector is specifically prohibited from unduly degrading the land

or the environment. The mineral prospector's incentive and reward for making a valuable mineral discovery is the prospector's assurance under Mining Law that he may develop the mineral deposit, and get a mineral patent.

If it ain't broke, don't fix it!

The Western Mining Council, and miners, strongly oppose the illegal use of mining claims and fraud in patent applications. The United States Mining Law and patent system should not be faulted and destroyed just because of the possible bad faith or fraud by an occasional dishonest patent applicant (which is almost always invariably exposed, and no patent issued). Such hasty action would be like closing down all of the Interstate

freeways because they are occasionally wrongfully used by drunk drivers or bank robbers. Without the incentive of the Mining Law we would not have our present mineral exploration and development system operating in the United States today.

Mr. Rahall, I implore you to consider the implications on the future of the United States if I have correctly answered your two questions. If these answers are wrong, I would certainly like to know. However, if these answers are accurate, the United States would be seriously hurt by the enactment of HR 3866. And, Mr. Rahall, I further respectfully ask you and the HR 3866 Subcommittee to fully examine the costs and detrimental effects of the destruction of our present efficient incentive-based Mining Law. *If it ain't broke, don't fix it!*



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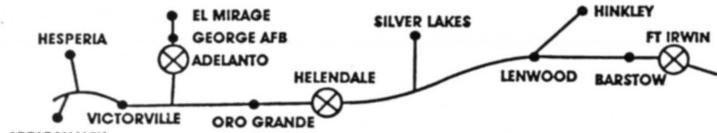
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GOFFS SCHOOLHOUSE
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For Further Reading

Cyanide in the Environment

Little information outside the scientific literature is available on this subject. This **Headframe** article is composed of excerpts from a book in progress on the subject. With the exception of *The Food Additives Book*, a university library must be utilized to find the sources listed.

The Food Additives Book, by N. Freyberg and H.W. Gortner, 1982. Contains information on all food additives and their safety.

Natural Degradation of Cyanides in Gold Milling Effluents, A progress Report, by J.W. Schmidt, L. Simovic and E. Shannon, 1981. Wastewater Technology Centre, Environment Canada.

Reviews of the Environmental Effects of Pollutants: V. Cyanide, by L.E. Towill et al, 1978. A primary source of information on cyanide at its effects. Oak Ridge National Laboratory.

Calico

The most comprehensive source of the geology of the Calico District is the series of three articles published by the California Division of Mines and Geology written by F. Harold Weber Jr. It can be found in most California libraries.

Silver Mining in Old Calico by F. Harold Weber, Jr., *Mineral Information Service* May, 1966.

Silver Deposits of the Calico District by F. Harold Weber, Jr., *Mineral Information Service*, January, 1967.

Silver Deposits of the Calico District by F. Harold Weber, Jr., *Mineral Information Service*, February, 1967.

Battle of Salamis

The Rise and Fall of Athens, Plutarch, Penguin Classics. This Greek historian produced a very readable account of the battle of Salamis. This original source also includes accounts of ghosts and other strange portents and omens associated with the event.

The Histories, Herodotus, Penguin Classics. The father of history, Herodotus, a fifth century B.C. Greek traveller, also is an early source for the Battle of Salamis.

Triremes

Engineering in the Ancient World, J.G. Landels, 1978. This book is still available and is an excellent source of information on triremes and other machinery of antiquity.

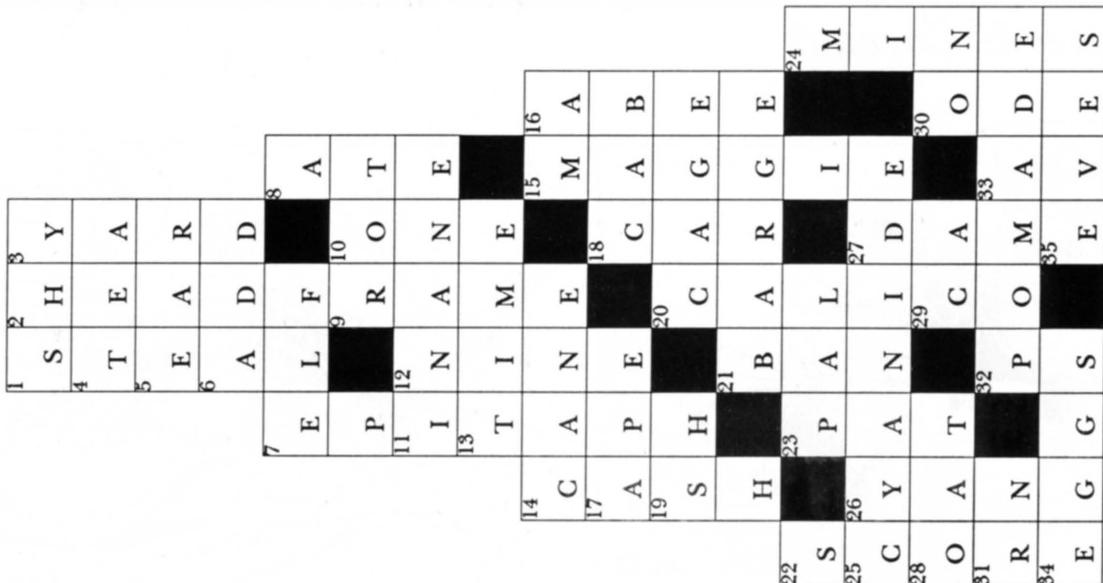
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CROSSWORD SOLUTION



GLOSSARY

adit: A horizontal passage into a mine, which is either <i>on</i> or <i>along</i> a vein.	over a mine shaft which enables the hoisting of men, materials and ore from within the mine to the surface.	face. The reverse is a <i>winze</i> . Which way you look (up or down) determines which it is.
alluvium: Erosion products moved and/or deposited by water.	horn silver: Silver chloride (AgCl , cerargyrite). A high-grade silver ore with the lustre of horn.	rhyolite: A fine-grained volcanic rock that is identical in composition to granite.
apex: The edge of a vein nearest the surface.	hydrolyze: The decomposition of organic compounds in water, e.g. cooking.	sarsaparilla: A soft-drink made from roots of a tropical climbing vine of the lily family. Similar to root beer in flavor.
assay: The process of determining the quantity of metal in an ore.	hydrothermal: Hot, mineral-bearing solutions, literally: hot water.	Sargon: A great Assyrian king whose name means "true-king".
base metal: A non-precious metal, e.g. copper, lead, zinc and iron.	igneous: Rock solidified from a molten state. (Latin: "fire".)	sheave: The large grooved wheel (pulley) mounted on top of a headframe. It permits the hoisting-cable to hoist from a shaft.
batholith: A mass of rock hundreds of square miles in area that has been intruded into older rocks.	in situ: Original location or place. (Latin: "in place".)	shelk: A silver coin weighing 0.3 ounce.
blocked-out: A volume of ore that has been delineated by drilling or workings.	ionize: Conversion to ions capable of chemical composition.	shoots: Sections of a vein where faulting across the fissure prior to mineral deposition permitted the formation of a roughly circular form. These portions run up the vein and have cross-sections thicker than the vein itself.
bonanza: A very rich discovery. (Spanish: success, fair weather.)	jaw crusher: A crusher with a hinge-like cross-section, one side being fixed and the other moving back and forth.	stope: The excavation made in mining a vein from between its walls.
breccia: Pieces of broken rock. (Italian: "rubble".)	Jurassic Period: A period of geologic time estimated to have been between 135-155 million years ago.	stull: A timber or platform placed between the vein walls to keep it open.
carcinogenic: Capable of causing cancer.	Laurium: The site of the famous Grecian silver mines of antiquity.	Sumerian: Sumer was a civilization that began about 3000 B.C. and was followed by the Babylonians and Chaldeans.
country rock: The rock enclosing veins; the dominant rock of a region.	level: A horizontal passage within an underground mine numbered from the surface, e.g. the 100-foot level.	tailings: The waste from an ore milling operation; not to be confused with the waste dump outside a mine portal.
cyanicides: Materials which combine with cyanide and neutralize its chemical activity; e.g. copper, lead, and zinc.	location: The process of "staking a claim" by placing monuments (posts or cairns) which establish the boundaries and by completing the necessary location notice.	tails: The waste from an ore milling operation; not to be confused with the mine dump out outside a mine portal.
denarius: A silver coin weighing 0.18 ounce.	lode: A mineralized fissure.	talent: A monetary weight of about 900 ounces used to weigh gold and silver. Its weight varied in time and place.
dike: A tabular mass of rock which cuts across another rock.	magma: Molten rock.	teratogenic: Capable of creating monsters, i.e. the hideously deformed.
doré: An alloy of gold and silver. (French: gilt, gilded, golden.)	magma chamber: A large chamber of magma beneath the earth's surface.	Tertiary: A period of geologic time estimated to have been between 2-67 million years ago.
drachma: A large silver coin weighing 1.38 ounces.	metamorphosed: Altered, changed to something different.	thrust fault: A fault which dips into the earth's crust at a shallow angle and has had the upper portion thrust up along the fault.
drift: An underground horizontal passage which follows a vein.	mina: A thick disc-shaped monetary weight of about 18 ounces used to weigh gold and silver. It was equal to 60 shekels or 100 denarii.	tufa: A sedimentary rock that formed by chemical precipitation out of spring, lake or percolating waters containing an excess of silica and/or calcium carbonate. It has the appearance of sinters.
dross: The impurities forming the scum on top of molten metal.	miner's candlestick: A wrought-iron contrivance which held a candle for use in an underground mine.	tunnel: Technically a horizontal passageway that opens at the surface on both ends, i.e. it penetrates the hill or mountain. Common usage denotes a horizontal passageway extending from the portal <i>through country rock</i> to a vein; any horizontal passageway that is not an adit or drift.
electrum: An alloy of gold and silver, variable ratios, about 50:50.	mining district: A self-government area established by miners with defined boundaries and rules of operation.	wall-rock: The rock on either side of a vein or ore deposit.
fault: A fracture in the earth's crust along which movement has occurred.	Miocene epoch: A epoch of geologic time estimated to have been between 5-23 million years ago.	windlass: A horizontal drum operated with a crank that is turned by hand. A rope winds around the drum and hoists the bucket below up to the surface.
faulted: Dislocation caused by faulting activity.	mutagenic: Capable of creating mutations.	winze: A vertical or angular passageway within a mine that reaches down to connect two or more levels of a mine. It does not reach the surface. The reverse is a <i>raise</i> . Which way you look (up or down) determines which it is.
fine: A measure of purity; absolute purity being 1000.	native: Naturally occurring metals without combination with sulfur, chlorine, et cetera; e.g. gold, silver, platinum, copper.	workings: The collective underground passageways, levels, drifts, et cetera, that are found in a mine.
footwall: The surface below a fault, vein or ore body.	obol: A very small silver coin weighing 0.716 grams.	zither: A stringed musical instrument whose strings are plucked with a pick. It can have from 30-40 strings.
float: Fragments of ore found downhill from the vein.	olios: A collection of musical pieces.	
free-milling: Particles of metal liberated from the rock by simple crushing.	ore: An economic term indicating a mineral that can be mined for a profit.	
geodes: A hollow round nodule with crystals projecting into the central void.	outcrop: Portions of veins or formations exposed on the surface.	
glucosides: Bitter tasting water soluble complex chemical compounds found in plants that break down into sugars and other compounds.	oxidized: Combined with oxygen.	
glory-hole: A large round excavation made to remove an ore shoot or a singular ore body.	porphyritic: A rock texture exhibiting visible crystals within a groundmass of crystals too small to be discrete.	
gossan: Oxidized pyrites (sulfur removed) capping a vein that has been exposed to the atmosphere for some time.	portal: The surface entrance to a mine.	
gouge: A layer of soft material composed of clay or crushed rock along a vein.	quartz: A common mineral found in veins; silicon dioxide (SiO_2).	
gyratory crusher: A rock crusher with a cylindrical wall and a central gyrating off-center solid cylinder. The rock is crushed between the solid cylinder and the enclosing wall.	quartz monzonite: A rock composed of quartz and feldspars (potassium, sodium, and calcium silicates).	
half-life: The period of time during which the chemical activity is reduced by 50%.	raise: A vertical or angling passageway within a mine that reaches up and connects two or more levels; it does not reach the sur-	
hanging wall: The surface above a fault, vein or ore body.		
headframe: The frame-structure located		

EDITORIAL

View from the Sheave Wheel: Big Mine, Little Mine

Recently a California newspaper published a widely circulated series of articles attacking the mining industry. The series dealt with alleged mining abuses and implied that there was a need for reform in the mining law. This series added fuel to a widespread drive by preservation groups to repeal these laws. [See *Testimony*, p. 37] These articles, however, were a distortion and misrepresentation of mining.

The implications were, that although the big companies were a problem, a greater villain was the small mine operator. Under the apparently invincible shield of "an antiquated 118-year old law", the small mine operator was out there in the wilderness, uncontrolled, raising marijuana, manufacturing illicit drugs, endangering the public health and, in general, raising havoc, plundering and pillaging the environment. The results of this heinous activity would be with us until the end of time.

The general public, however, was given the impression that there was something drastically wrong with the mining law which was obviously overdue for correction. The implication was that the small mine operator was a renegade overdue for incarceration. Such people were able to operate patently illegal activities under the protection of a law that made the regulators somehow unable to act on clear violations of criminal law. That the examples cited were the results of those using the mining law as a cover for their illicit activities did not seem to enter the writers minds.

Not mentioned in the discussions was what actually constituted a small mine, or for that matter a big mine. When this position is placed in some perspective we see what is a veiled attack on the industry via the straw-dog of the small mine operator. However, if one looks at what actually constitutes a small mine, a far different reality emerges.

The size of a mining operation (a mine) can be measured by a number of criteria. For example the definition can be related to a specific mineral commodity such as coal. Small coal mines for example, are considered to be those which produce less than 100,000 tons per year and employ fewer than 20 people. Other such factors as the size of the ore deposit, mill production, number of employees can and have been used to define mine-size. In the industry, mine-size is typically measured by the size of the ore deposit and/or mill production.

In California the weapon of choice used by preservation groups is always environmental. The result being regulatory over-kill which threatens all industry. In an attempt to bring some order and perspective into the discussion, working definitions were developed by a southern California industry group. The Mojave Desert Mining Advisory Council (MDMAC), a loose-knit group of about 30 small, medium and large mining companies, with a combined production of roughly \$400,000,000 and 1500 employees, considered these definitions to be important. Since surface disturbance is the focus for most preservation groups, it was felt that mill capacity was a good measure to use since it reflected, to a fair degree, the amount of surface disturbing activity. The follow-

ing criteria defining mine-size based on mill production were adopted by the MDMAC.

<u>SIZE</u>	<u>MILL PRODUCTION*</u>
Small	up to 500
Medium	501-1000
Large	1000-3000
World-class	3000+

* tons per day

These criteria apply to an open pit mine only until the ultimate pit perimeter has been attained. Once that point has been reached the surface disturbance can drop to near zero, the subsequent mining activity being contained within the pit confines.

Another measure of a mine's size is that of the ore deposit. Due to the unique three-dimensional geometry of every ore deposit, its size cannot be directly related to surface disturbance. It is an important classification however.

The following criteria defining mine-size based on ore deposit size were also adopted by the MDMAC.

<u>SIZE</u>	<u>TONS</u>
Small	up to 3,000,000
Medium	3-10,000,000
Large	10-20,000,000
World-class	20,000,000+

The number of employees was not considered pertinent to mine-size since there is no universal relationship between employees and surface disturbance. Employee numbers vary greatly due to the mineral being mined, the type of deposit being worked and the mining method being used. Small mines generally employ less than 20 people while large mines provide jobs for over 100 people.

As can be seen in this brief discussion, a small mine can be a valuable producer employing dozens of people. Contrary to the straw-dog caricature being put forth by preservationists, a small mine operator fills an important place in our society. In order to garner public support for their activities, preservationists hold up images that at best are erroneous, veiling their real goals. As they use the spotted-owl against the timber industry, the snail-darter against power companies, they are now using a fictitious image of the small mine operator against the mining industry.

The public must be informed of the facts and be made aware of the distortions and falsehoods being peddled in the name of the environment. If not, we may some day find we are faced with another highly vocal and demanding group called the "Friends of Bacteria" — then we will really be in for a time of it!

M.E.II

ENTER THE WORLD OF MINING & THE 1990's

HEADFRAME is an eclectic magazine which explores the world of mining, both past and present.

The general public cannot casually enter and operating mine for a look-see. Through the pages of HEADFRAME the inquisitive reader will be taken on in-depth tour of operating mines of all kinds.

Every mine is unique. HEADFRAME will explain why the mine is located where it is, the nature of the ore deposit and its origin. We will also look at how the deposit is mined and how the mine is operated. The environmental setting, impacts, mitigations and reclamation will also be addressed.

Historic mining districts their mines, the life and times of the period will be reviewed. As with current mines, why they were located there and the nature of the ore deposits and operations will be reported. The people and their lives will also be noted along with biographies of those of note or reputation.

We are in large part unaware of the role that various minerals play in our lives. HEADFRAME will look at how minerals are used by society, how these needs are met and how these needs will be met in the future.

The machinery, devices and processes used in mining now and in the past will be covered.

Environmental concerns and issues surround us today as never before. Environmental allegations are being levied against mining and other basic industries. HEADFRAME will analyze these issues and report their validity and the associated societal ramifications.

HEADFRAME will from time to time have mining-related travel suggestions and special articles on flora and fauna, book reviews and some surprises.

We are interested in meeting our reader's interest and therefore welcome any suggestions for subjects and topics for future publication. We are also interested in any improvements we can make to meet the reader's interests. Let us know your questions and we will endeavor to find the answers in a future issue of HEADFRAME.

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